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CLINICAL AND ROENTGEN-RAY FINDINGS IN THE HEALTHY ADULT CHEST*

REPORT OF COMMITTEE OF THE NATIONAL TUBERCULOSIS ASSOCIATION

IN 1920 the Committee on Medical Research of the National Tuberculosis Association, under the grant of the Association, appointed the following group of clinicians and roentgenologists to establish the roentgen-ray and clinical findings in the chest of the normal or healthy child between the ages of six and ten years:

Dr. H. K. Pancoast and Dr. H. R. M. Landis, University of Pennsylvania.

Dr. F. H. Baetjer and Dr. C. R. Austrian, Johns Hopkins University.

Dr. H. K. Dunham and Dr. K. D. Blackfan, University of Cincinnati.

The report of this roentgen-ray and clinical group was presented before the meeting of the National Tuberculosis Association in 1922, and was published in the Transactions of the Association. As the work of this group seemed to have produced satisfactory results, the Committee on Medical Research requested that the members continue their studies on the chests of healthy adults, which the members agreed to do. As Dr. Blackfan's interest was in the line of pediatrics, Dr. Roger Morris was nominated to take his place as the associate of Dr. Dunham.

In January, 1923, the members of the group met to determine the policy of their investigations, and certain articles of agreement were adopted as a guide to the workings and investigations of the sub-groups, substantially as follows:

A. GENERAL PROBLEM

Two age periods were adopted for study; namely, from the ages of approximately twenty to thirty years and from forty-five years on. A period of one and one-half decades was omitted in order to emphasize differences in appearance with advancing years.

B. THE CLINICAL PROBLEM

The clinician of each sub-group was to *personally* examine the individuals selected for the purpose at hand. Only clinically normal or healthy individuals were to be selected for purposes of study, clinically or roentgenologically, provided any abnormality elsewhere in the body did not in any way affect the chest.

A clinical history was to be made in connection with each individual examined and was to embody the following questions and investigations:

1. Family history, including any history of exposure to respiratory infections to which the individuals selected for study might have been subjected in his family relations.

2. Routine past history of the individual.

3. History of childhood infections, especially measles and whooping cough, and dates of the same.

4. History of any respiratory infections, including influenza, and dates of the same.

* This Report is also published in the April, 1927, number of the *American Review of Tuberculosis*, to whose editor we are indebted for permission to republish the article, and for the blocks for the accompanying illustrations.

5. History of repeated colds.
6. Place of birth and abode of the individual.
7. History of "gassing" if in the army during the war.
8. Each occupation engaged in.
9. Routine Wassermann test if found advisable or necessary.
10. Examine particularly for sinus disease and either discard positive cases or group them.

C. THE ROENTGEN-RAY PROBLEM

In studying the markings in the lungs, it was decided to attempt to make use of both stereoscopic and flat roentgenograms, for two reasons; first, because it was recognized that each method in itself was a sufficient method of study when utilized by an observer trained to the use of it and practiced in the procedure of interpretation, and second, because many examinations of chests must, of necessity, be made by flat films alone, because of grave illness of the patient.

The Base. Relatively circumscribed densities in the lower lobe presenting an appearance of a localized exudate, or density, or suggesting a pulmonary exudate, even without giving evidence of any abnormality clinically, were to be excluded from the normal. Individuals presenting definite roentgen evidence of pleural adhesions, partially or totally obliterating the costophrenic angle, and presenting no other definite abnormal appearances in the chest, were to be accepted for normal study, provided they were passed as normal clinically. (The wisdom of this clause was realized by one of the sub-groups when two years later one of the greatest middle distance runners of this country was passed over to the roentgenologist as having a healthy chest and roentgenoscopic examination showed the right costophrenic angle completely obliterated by adhesions and the diaphragm very much restricted. This was confirmed by the roentgenograms which showed adhesions also, but to a less extent, in the left costophrenic angle.)

The Hilum. Calcified nodes in the hilum, without evidences of pulmonary disease, were to be disregarded except as evidences of past infection. At that time the groups were inclined to regard calcifications as not necessarily tuberculous, but at later meetings, they became more of the opinion that these were usually tuberculous in origin. The "inverted comma" was, of itself, to be disregarded. An attempt was to be made to define the extent of the normal hilum shadow on the basis of both stereoscopic and flat film impressions, especially in relation to the three zone division of the lung as described in the report on the normal chest of the child. It was assumed that the density of the hilum shadow would be found such as to permit the preservation of the trunk shadows within it in normally exposed films. In so far as possible, the descriptions employed in the child's chest were to be followed in describing the hilum and trunk shadows in the adult.

The Apical Region. The status of evidence of thickened pleura in the apex and whether it should be admitted for the purpose of study of the otherwise normal or healthy chest was left for later decision, as was also the status of thickened trunk shadows extending to the apical region. A single thickened trunk shadow extending to the apical periphery, with evidence of a fan shadow plus localized pleural thickening at the periphery of the fan was to be regarded as evidence of tuberculosis, past or present. A thickened trunk shadow with a fan shadow, without pleural thickening, was also to be so regarded. A thickened trunk shadow alone was not to be so regarded.

Displacement of the trachea without thyroid enlargement, scoliosis, aneurysm, aortic dilatation, enlarged heart, neoplasm, and no evidence of any abnormal lung or pleural condition was not to exclude the individual from selection for study of a normal or healthy chest. All such cases were to be reported, however. Individuals showing slight interlobar pleural thickening without any other abnormality were to be admitted for normal study.

As the work of the sub-groups was nearing completion, another meeting was held two years later, in 1925, to further determine their policies and to attempt to agree upon certain additional observations

to be made in the interpretations of roentgenograms. As the importance of the field of study was becoming more apparent, consultations were requested, and Dr. William Charles White, Dr. Eugene L. Opie and Dr. Elmer H. Funk were invited to attend.

The subject of calcifications received prolonged discussion, and it was finally agreed after consultation with Dr. Opie that calcified spots in the hilum and in the parenchyma of the lungs, without other roentgen evidence of tuberculosis, could be regarded as negative in the absence of any positive clinical evidence of the disease. The group accepted as a fact that such calcifications rarely if ever occurred except as sequelæ of tuberculous infections, and that elsewhere than the apices probably indicated healed tuberculous foci of childhood.

In view of the many variations found in the roentgen appearance of the adult chest, apparently within normal limits, and the many lasting evidences of previous disease found in clinically normal chests, it was decided to discontinue the use of the term "*normal chest*" and adopt that of "*healthy chest.*"

In order to increase the value of the contribution, it was decided to include in the studies the relations of and variations in all possible extra pulmonary shadows, such as the ribs, trachea and its bifurcation, the aorta, the heart and the diaphragms. It was further suggested that an attempt be made to determine the divisions of the bronchial tree in relation to lobes as an aid in determining the location of lobes and interlobar fissures, and to designate by name in a convenient manner all of the more important and constant trunk shadows.

The final meeting of the groups was held at the Henry Phipps Institute, Philadelphia, May 2, 1926 for the purpose of formulating a final report on the investigations carried out on the healthy adult chest over a period of three years. The following individuals were invited to attend the meeting in consultation in order that their advice might be sought on various points in the drawing up of conclusions: Drs. William Charles White, Charles J. Hatfield and Paul A. Lewis, representing the Research Committee of the National Tuberculosis Association; Dr. Eugene L. Opie, consultant in pathology; Dr. David R. Lyman, representing the Executive Committee of the National Tuberculosis Association; Dr. Gabriel Tucker, representing Dr. Chevalier Jackson; Dr. F. Maurice McPhedran, roentgenologist of the Henry Phipps Institute; and, because of their close association with the work of the Philadelphia sub-group; Drs. Eugene P. Pendergrass, Kenneth D. A. Allen and DeWitt Kluttz.

REPORT OF THE ROENTGEN-RAY GROUP

The roentgen group has examined 280 clinically healthy adult chests as presented to them by the internist members of the Committee. The cases chosen represented for the most part two adult age periods—eighteen to thirty years and forty years on, for purposes of comparison. Two hundred of the individuals were examined by stereoscopic roentgenograms and 80 by flat films. One hundred of the former group had lateral roentgenograms made for purposes of study in that view, which is receiving a recognition of increasing importance.

It is not the purpose of the roentgen group to enter into a discussion of technique except to state that all chest roentgenograms intended for lung diagnosis must be of the best possible quality, and stereoscopic films must stereoscope perfectly. There must be as good contact as possible of all parts of the individual's chest with the film or cassette holder. The arms should be thrown away from the sides of the chest to show the axillary folds, and the scapulae should be clear of the lung fields. The individual and tube must be symmetrically placed so that the sternal ends of the clavicles will appear equidistant from the spine. Penetration should be such as to bring out the decreased density of the trachea and the right and left bronchi. When flat films are used, the breast shadow in the female may be confusing, and it may be necessary to make an exposure with the breasts pulled upward and outward and another with the breasts pulled downward in order not to obscure a

basal lesion or have one suggested that is not present.

THE BONES

All of the bones included in the exposures should be carefully noted. Organized pleural exudate at one base is apt to contract the ribs in that locality. Anomalies such as cervical and bicipital ribs are likely to be found in between 1 and 2 per cent of cases examined. Calcification of costal cartilages has no bearing, so far as we could determine, upon any pathological condition, and means nothing except that in a general way it is more progressive with advancing years, with the following exceptions: Calcification of the first cartilage occurs comparatively early, especially in men, and it is very commonly found in the lower cartilages in young thin women. Comparative fixation may play some part in this.

Careful measurements seemed to indicate that in emphysema and in deep breathers such as athletes, the ribs are not further apart, but come off from the spine at nearer a right angle and are more nearly horizontal. This is especially demonstrable in the lateral view.

Scoliosis of minor degrees is of no significance in healthy chests, except that one must not misjudge slight displacement of the trachea or other structures because of it.

SOFT PARTS

Approximate development of fat and musculature can be readily determined from the roentgenograms. By a study of the axillary folds we may be able to judge that the individual is of average nourishment, well nourished, under nourished, obese or decidedly under weight. Greatly increased weight, especially in the obese, causes a higher position of the domes of the diaphragms and this in turn tends to push the heart upward and to the left, both of which tend to obscure the lung bases to a certain extent. The heart may change its position as much as two inches between forced expiration and inspiration in stout individuals.

THE DIAPHRAGMS

Diaphragmatic excursion was very variable. In athletes and in older adults, it was rather uniformly good. Reference has already been made to the middle distance runner in whom bilateral adhesions caused very marked diaphragmatic restriction which seemed not in the least to interfere with his athletic prowess. Excursion was rather uniformly poor in thin women.

The roentgen group strongly recommends the use of the term "*dome of the diaphragm*" rather than "*diaphragm*" as descriptive of the curve of the diaphragm shadow as seen in the posteroanterior view.

The right dome was almost always higher by an average of 1.5 cm. in full inspiration. In a few instances both domes were the same level and in these individuals the attachment of the inner portion of the right diaphragm was found higher than that of the left. Regular inequalities or waves in a diaphragm dome of normal level are due to different levels of attachment, provided inequalities in the upper surface of the liver can be excluded on the right side.

Sharp peaks or tenting of the dome are due to abnormal attachments such as pleural adhesions, or to changes in the lungs, usually fibrosis. These may be better located and studied to better advantage in the lateral vieiw.

The diaphragms will be considered further in a separate discussion of the lateral view of the chest.

THE HEART

The *apex location*, as indicated in the roentgenogram, corresponds closely with the location found clinically, except that in about 50 per cent of cases it was found behind the sixth rib, in the erect posture and during full inspiration, and in the other 50 per cent was more often on a level with the sixth interspace than the fifth (Fig. 1). The location will vary with the position of the individual, the size, and the amount of abdominal fat or distention. At first it was thought that there was considerable difference in the location of the apex clinically and roentgenographically in reference to the midclavicular line, until it was discovered that the location of the clinical midclavicular line and that of the roentgenographic midclavicular line frequently differed

quite considerably. The roentgenologist drops a line directly downward from a point on the clavicle midway between the sternal and acromial ends. Such a midclavicular line does not often run through the middle of the dome of the left diaphragm, especially in thin women, but usually through a point 1 to 2 cm. outside the middle of the dome (Fig. 1). The heart apex was found within the roentgen midclavicular line in the majority of individuals. It was at or outside this line mostly in older individuals and athletes. This question was discussed at length by the clinical and roentgen members of the group and the danger of the use of the midclavicular line was recognized as a matter of clinical importance. It was resolved that from the evidence of roentgenograms the wide variation in the position of the midclavicular

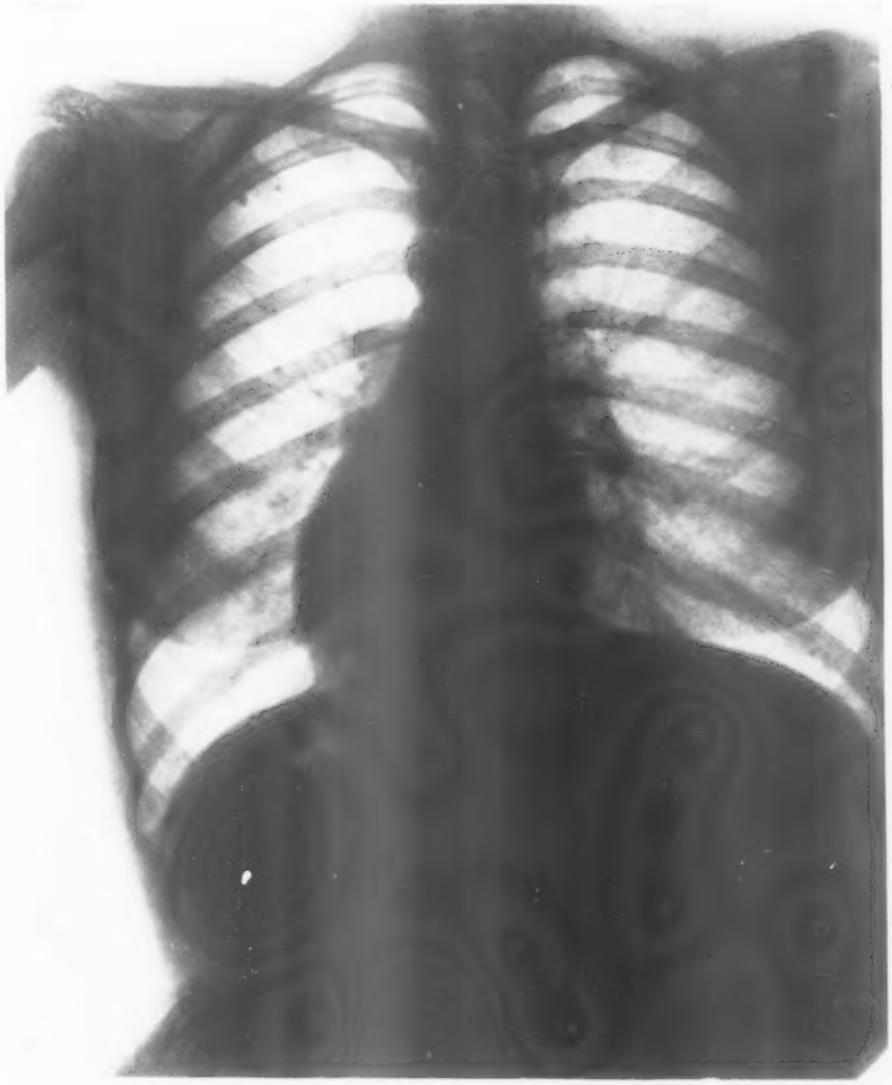

FIG. 1. Posteroanterior view of the chest of a healthy, well built adult female (nurse) aged twenty. The following points are referred to in the text: (1) A line dropped perpendicularly from the clavicle at a point midway between the sternal and acromial ends passes well outside the middle of the dome of the left diaphragm, and the apex of the heart is well within the roentgenographic midclavicular line. (2) The apex is behind the sixth rib or just below it. (3) Calcifications in the left hilum and left upper lobe are not regarded as pathological.

line in its relation to internal structures makes it an unsafe line to use for body measurements. It was recommended, therefore, that in clinical measurements for the apex location and size of the heart, they be measured always from the midline of the body.

FIG. 2. Lateral view of the same individual as Figure 1. The hilum calcifications are seen also in this view. Hilum thickness is indicated, but the two sides overlap and measurements would be difficult or impossible. The composite shadow of the pericardium and inferior vena cava is indicated by an arrow. The diaphragm domes are parallel throughout. Note the much lower level of the posterior costophrenic sulcus.

It is obvious that accurate heart measurements can be made only with the film in front of the patient.

Measurements of the heart shadow were made in a large number of individuals as a matter of record. Those made were the greatest midline right and midline left dimensions and the aortic shadow width. The anteroposterior dimension was also made in the lateral views. The midline left and anteroposterior dimensions were found to be greatest in the older men, in whom, also, there was an increase in the average width of the chest. The angle of the heart axis with the midline was increased most in older men and in the obese.

The heart is further considered under the lateral view of the chest.

THE AORTA

The aortic shadow does not extend to the right of the vertebrae normally, but does extend to the left in all instances. The top of the aortic shadow was found to extend to a point varying between the fourth and sixth thoracic vertebrae. In more than two-thirds of the cases examined it was on a level with the body of the fifth vertebra. Apparently there is little or no

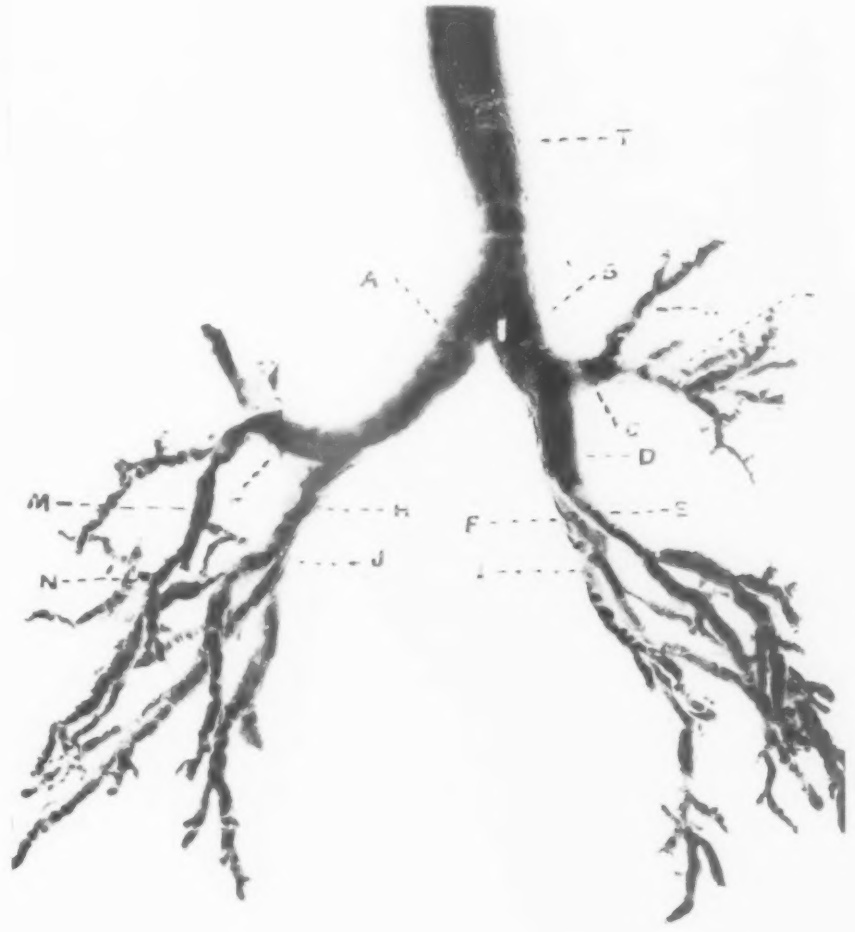

FIG. 3. Photograph of a white metal cast of the bronchial tree loaned to the Committee for study by Dr. Schaeffer of the Jefferson Medical College through Dr. Chevalier Jackson. T, trachea; A, left bronchus; F, right bronchus; C, right upper lobe bronchus; D, right stem bronchus; E, right middle bronchus; T, right lower lobe bronchus; G, left upper lobe bronchus; H, left lower lobe bronchus; I, point of division of right lower lobe bronchus into its lower lobe branches; J, similar point on left lower lobe bronchus; K, vertebral trunk; L, second interspace trunk; M, trunk to the lingual tip of the left upper lobe; N, branch of the left lower lobe bronchus to the apex of the left lower lobe. The corresponding branch on the right side is not shown.

difference with age, but the height will vary with technique, in that differences in level of the roentgen tube in relation with the patient will alter the vertebral level of the top of the aortic shadow. The lower the tube, the *lower* will be the apparent level of the aorta, because it is nearer the film. The width of the aortic arch shadow varies somewhat with size, age and habitus of the individual and the distance of the tube from the film. Estimations of width should be made with the film in front of the patient. The final decision as to dilatation must be determined by roentgenoscopy as well as from the roentgenogram.

The aorta will be considered further under the lateral view of the chest.

THE TRACHEA

As previously stated, all properly exposed roentgenograms should show the decreased density of the trachea, the carina and the right and left bronchi. It is exceedingly important to be able to detect deviations of the trachea and narrowing of the lumina of the trachea and right and left

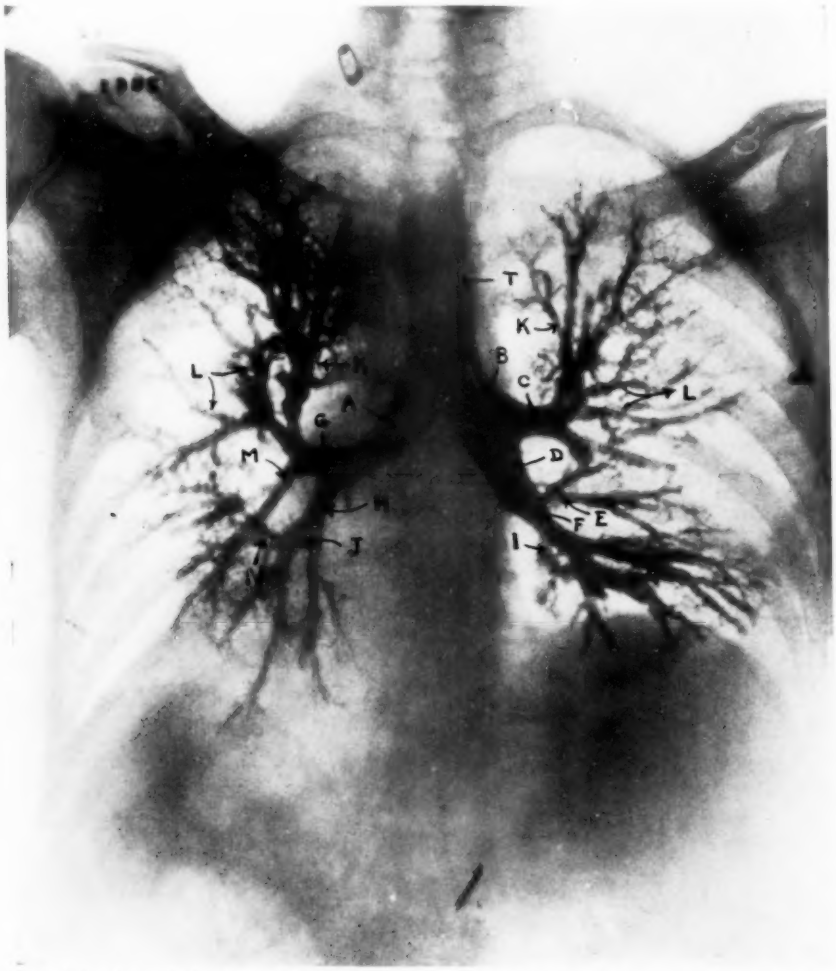

FIG. 4a. Bismuth injection of the lungs in a cadaver immediately after death, showing the trachea, the right and the left bronchus and the divisions of the bronchi to all the lobes. The observer can work out from this illustration all of the important trunk shadows mentioned in this report. There may be some difficulty encountered in applying the right middle lobe bronchus, E, the branch of the left upper lobe bronchus to the lingual tip, V, and that of the lower lobe bronchus, N, to the apex of the lower lobe to their respective trunk shadows in stereoscopic roentgenograms. For identification of letters in this illustration, see Figure 3.

bronchi. With proper technique as to the placing of the individual symmetrically with the central ray passing through the center of the body, so that the sternal ends of the clavicle will be equidistant from the spine, and with the neck straight, the trachea in its upper portion will be almost universally in the midline. Any deviations

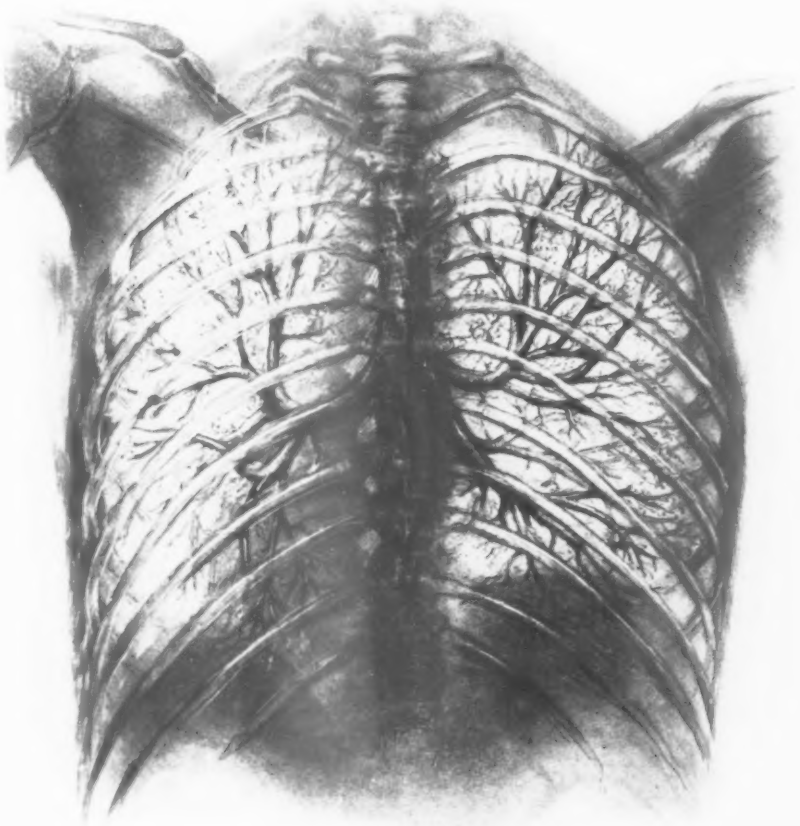

FIG. 4*b*. Composite drawing made essentially from the film represented by Figure 4*a*, showing the anatomical relations of trunks to better advantage. For identification of trunk shadows or bronchial tree branches see legends of Figures 3 and 4*a*.

to the right or left above the lower levels of the clavicles are exceedingly slight. In its lower portion, it slopes slightly to the right, toward the aorta. Minor degrees of scoliosis will tend to give the impression of lateral deviation. The lumen was found fairly uniform throughout, in all cases examined.

A description of the location of the bifurcation of the trachea should be that of the carina. It can be observed only with comparatively high penetration. It was found at levels varying between the body of the fifth and the top of the body of the seventh thoracic vertebrae, and in front of the sixth vertebra in about two-thirds of the individuals examined. It was lower in older persons and higher in women than in men. One of the group thought that the tendency to anteroposterior bowing of the spine might account for the apparent lower position in older persons. The level of the roentgen tube will have some bearing on the relative height of the carina.

The carina was found in the midline, or, more frequently, slightly to the right.

THE BRONCHI

The top of the right and of the left

bronchi crossed the right and left borders of the thoracic spine slightly below the carina level.

The so-called "*inverted comma*" was very frequently found, and usually on the right side. It is a normal appearance and never represents any pathological condition. Its tail is the side of the tracheal shadow and its lower border represents the top of the bronchial wall on that side.

In the lateral view of the chest, the right bronchus was always slightly anterior to the left bronchus.

FIG. 5. Lipiodol injection made by Dr. Tucker through bronchoscope directly into the right lower lobe bronchus. Female, aged twenty-three. The clubbed ends of the branches of the right lower lobe bronchus indicate bronchiectasis, for the diagnosis and localization of which the injection was made. Note the high level of the apex of the lower lobe as indicated in the higher part of the injection.

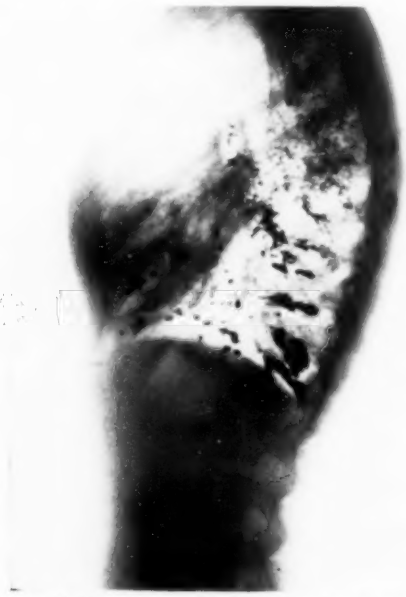

FIG. 6. Lateral view of the same case as Figure 5, showing the extent of the lower lobe and the high level of its apex posteriorly. The bronchiectasis is posterior.

THE HILUM SHADOW

Although the composition of the hilum shadow is a generally recognized fact, an exact description of the normal hilum and its boundaries presents a very difficult problem. As this shadow is subject to so much change within normal limits and is so very frequently affected by pathological conditions within the chest, it becomes very necessary to define the roentgen hilum in the healthy chest. The anatomical hilum is wholly outside the lung. The roentgen hilum must, of necessity, include a small portion of the root of the lung. The hilum shadow is a conglomerate shadow cast by the bronchi, pulmonary arteries, pulmonary vein, bronchial and some pulmonary lymph nodes and connective tissue around the root of the lung. It is a hazy shadow, irregular in outline but fairly constant in extent. Its density will vary with the roentgenographic exposure, and unfortunately, within normal limits. The trunk shadows included within its limits should be seen through in normally exposed films. If made up entirely or in part of a solid mass of homogeneous shadow, the appearance is abnormal.

As there is considerable difference of opinion among roentgenologists as to the exact extent or the anatomical limits of the hilum shadows, it has seemed pertinent to suggest certain boundaries which it is hoped may prove acceptable.

The outer boundary is the most uncertain one. Roughly, it has been regarded as extending to a line limiting the inner zone or third of the lung field. Exact measurements are not possible as they are so variable, and will depend upon tech-

nique. In a number of films measured, the width varied from 5 to 7.5 cm. from the midline, at 4 feet target plate distance.

On the right side, the normal shadow may be said to extend from above downward from the top of the right main bronchus (B, Figs. 3 and 4) to approximately a point where the right lower lobe bronchus, below the origin of the middle lobe trunk, begins to subdivide (1, Figs. 3 and 4) into its lower lobe branches (or trunks) (Fig. 11). This includes the anatomical hilum, the greater portions of the larger bronchi and some lung tissue in front and behind. The extent of this hilum shadow from above downward is approximately two interspaces and a rib.

On the left side, the pulmonary artery passes above the left bronchus (A, Fig. 3), and from above downward the left hilum shadow may be said to extend from the upper border of the pulmonary artery down to approximately a point where the left lower lobe bronchus begins to subdivide (J, Fig. 3) into its lower lobe branches (or trunks). Such a hilum shadow on this side is slightly shorter than the one on the right and is slightly less than two interspaces and one rib in length.

While the top of the right bronchus is higher than the left, if the tops of the hilum shadows be limited in the manner just described, they are on a plane approximately level.

The thickness of the hilum shadow in the anteroposterior direction is a matter that requires further study, and probably largely from the lateral view. Measurements from lateral views are very uncertain and subject to considerable personal equation. One should learn to acquire the idea of depth as well as length and width when interpreting hilum shadows.

FIG. 7. Lateral view of the chest of a healthy adult female (nurse) aged twenty. Note the contact of the heart shadow with that of the anterior chest wall for a considerable distance and the composite shadow of pericardium and inferior vena cava. The retrocardiac space is a truncated isosceles triangle in shape. The shadows of the diaphragm domes cross at about the midline or a little posterior to that point.

FIG. 8. Lateral view of the chest of a healthy adult male, aged sixty-eight. The heart shadow is in contact with that of the anterior chest wall for only a comparatively short distance. The composite pericardium and inferior vena cava shadow is slightly overlapped by the heart. The retrocardiac space is a truncated isosceles triangle in shape. The diaphragm domes cross well posterior to the midline.

THE TRUNK SHADOWS

Extending from the hilum, heavy trunk shadows pass to each lobe. It has been previously proven that these trunk shadows represent artery, bronchus and vein. The important point to remember is

that each of these trunks contains a bronchus, and that when the trunk shadows are visible it is possible to map out definitely the location of the various lobes and their bronchi. This can be done readily in stereoscopic roentgenograms, but it is not possible to differentiate the bronchi so well in flat films.

As the structures in the trunks are accompanied by peribronchial and perivascular lymphatics, their shadows may become modified by fibrosis attending old age and following previously existing

FIG. 9. Lateral view of the chest of a healthy adult male (athlete) aged twenty-eight. The retrocardiac space is large and a truncated right angled triangle in shape because the anteroposterior diameter of the chest is large and aeration is better than in the average individual. The sternum is not bowed nor the spine bent as in emphysema. The ribs are more horizontal than in thin chests.

respiratory tract infections. As a result, the trunk shadows are commonly found to be more prominent with advancing years. Careful comparative measurements made at different ages by one member of the group showed that the trunk shadows did not increase materially in width with age, but presented greater density of shadow, particularly in the presence of emphysema. It was generally agreed that thickening or increased prominence of the trunks to the apices was unusual in the healthy chest. It may or may not be an evidence of disease. Comment on this question has already been made in one of the preceding meeting reports.

Foreign bodies in the air passages must be located in the bronchus or branch in which they lie. It is very desirable to locate many lesions, such as abscesses, in the lobe or part of the lobe in which they are present, and such localization depends upon a knowledge of the trunk shadows and their distribution. Differentiation of location in the upper lobe or apex of the lower lobe frequently depends upon stereoscopic location and identification of trunks going to the affected area. For purposes of description, it is very essential that the more important trunks be named and their locations described. There should also be a general agreement as to the names of the bronchi and their relations.

The right bronchus or right main bronchus is almost a continuation of the trachea (T, Figs. 3 and 4) except that it bears a little more sharply to the right (B, Figs. 3 and 4). The *right upper lobe bronchus* is the first subdivision and comes off from the main bronchus at an angle of about 90° (C, Figs. 3 and 4). As this branch passes above the right pulmonary artery it is sometimes called the eparterial bronchus. The eparterial bronchus shortly divides into other branches: (1) Trunks come off at a sharp angle and pass upward to the apex of the upper lobe, parallel to the spine (K, Figs. 3 and 4). These have been named the *vertebral trunks*, and have an anterior and posterior distribution which can be seen in unusually clear stereoscopic films. This anterior and posterior branching is common to all upper lobe trunks. (2) *Second interspace trunks*, coming off behind the level of the second interspace in front, are heavy trunks distributed from behind the second interspace and extending down behind the third interspace. This set of trunks gives off anterior and posterior branches, as is characteristic of all upper lobe trunks. These branches go to the lower parts of the right upper lobe (L, Figs. 3 and 4). This set of trunks comprise anatomical entities found on careful dissection. They are easily observed.

A third set of trunks may be visualized

behind the *first interspace*. This is not an anatomical entity, but made up of branches from the vertebral and second interspace trunks.

The right stem bronchus is the portion of the right bronchus between the points at which the upper lobe and the middle lobe bronchi are given off (D, Figs. 3 and 4). It is very important to designate this area because it is so frequently the point of

FIG. 10. Lateral view of the chest of a healthy adult female aged forty-nine, except that she was emphysematous. The retrocardiac space is a vertical rectangle in shape. The diaphragm domes cross posterior to the midline. Because of the emphysema the anteroposterior diameter of the chest is increased and in the upper portion this is aided by bowing of the sternum and a broad regular kyphosis. The sternoaortic space is increased and the heart shadow is hardly in contact with the chest wall. The composite shadow of the pericardial reflection and inferior vena cava, indicated by an arrow, is much more dense than the descending thoracic aorta. The arch shows probably because of emphysema.

lodgment of foreign bodies. This is the portion of the right bronchial tree over which the pulmonary artery crosses.

film. It is seen to good advantage in stereoscopic films only. It has two main branches, one passing down and anteriorly and the

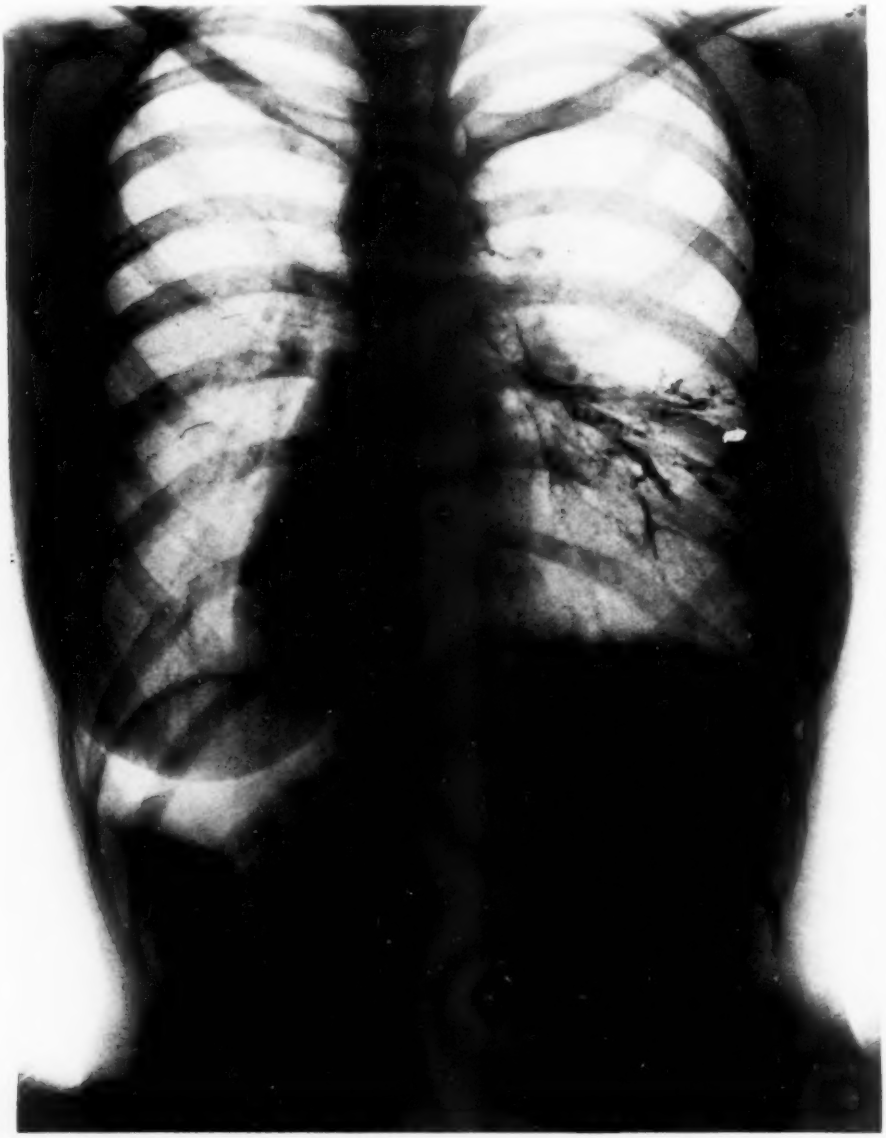

FIG. 11. Bismuth insufflation of right middle lobe bronchus, showing it branching from the stem bronchus and also its two main branches. Patient examined for Dr. Gabriel Tucker. The top of the right bronchus is faintly outlined as are also the lower lobe bronchus and its branches, and the proposed upper and lower limits of the hilum shadow are thus indicated.

The right middle lobe bronchus (E, Figs. 3 and 4) is given off *anteriorly* from the stem bronchus at a considerable distance below the upper lobe or eparterial bronchus. This trunk passes in an anterior direction and appears very short in a flat other up and laterally (Fig. 11). This trunk is important for purposes of localization in posteroanterior views.

The right lower lobe bronchus is a very short portion of the right trunk system between the middle lobe bronchus and the

bifurcation of trunks to the lower lobe (F, Figs. 3 and 4).

The numerous trunks given off from the lower lobe bronchus have not been classified. They show great anatomical variation and differ considerably on the two sides. They may become better known through familiarity with iodized oil injections. In the posteroanterior view they are so numerous and superimposed that identification

FIG. 12. Lateral view of the chest of a male, aged sixty-three. There is a supposed tumor in the right upper lobe indicated by the rounded denser shadow, while the remaining portion of the lobe is clouded by atelectasis due to obstruction in the upper lobe bronchus (A, Fig. 14). Below the upper lobe, in front, is the less dense middle lobe, shown throughout its greatest extent, with the apex approximately at the point indicated by the arrow. The fissure between the upper and lower lobe posteriorly and the middle and lower lobe anteriorly is indicated by pleural exudate. While this does not indicate a normal or healthy chest, the pathological features distort but little, and the illustration shows the location of the three lobes in the lateral view probably better than they could be shown in any other way during life. Later studies of this case showed a cavity in the supposed tumor shadow and the diagnosis was changed to abscess, which was confirmed at operation.

of individual trunks is almost impossible. Both posteroanterior and lateral views may assist in identification. We could, of course, group them in a general way into mesial or vertebral, posterior, lateral and apical or superior trunks. The last trunk is an entity and is equally definite on both the right and left sides. It is seen to pass backward from the hilum inside the midscapular line. Its ultimate branches are not generally visualized. Visualization of this trunk identifies the upper third of the lower lobe.

FIG. 13. The same case as Figure 12, after lipiodol injection into the right bronchus. This shows the distribution of the middle lobe bronchus, B, and its branches, and that of the lower lobe bronchus and its branches. The branch to the upper portion of the lower lobe, coming off at point C, does not have its upper divisions filled.

The use of direct intrabronchial injections of iodized oil presents some surprising features in regard to lower lobe trunk distribution, and especially that to the apex of the lower lobe. Figures 5 and 6 show the

height of the apex of this lobe as indicated by a lipiodol injection in a case of bronchiectasis of the right lower lobe. The lateral view (Fig. 6) shows how high the lower lobe without stereoscopic identification of trunk shadows in the posteroanterior films, preferably aided by a lateral view. Such localization may not be of so

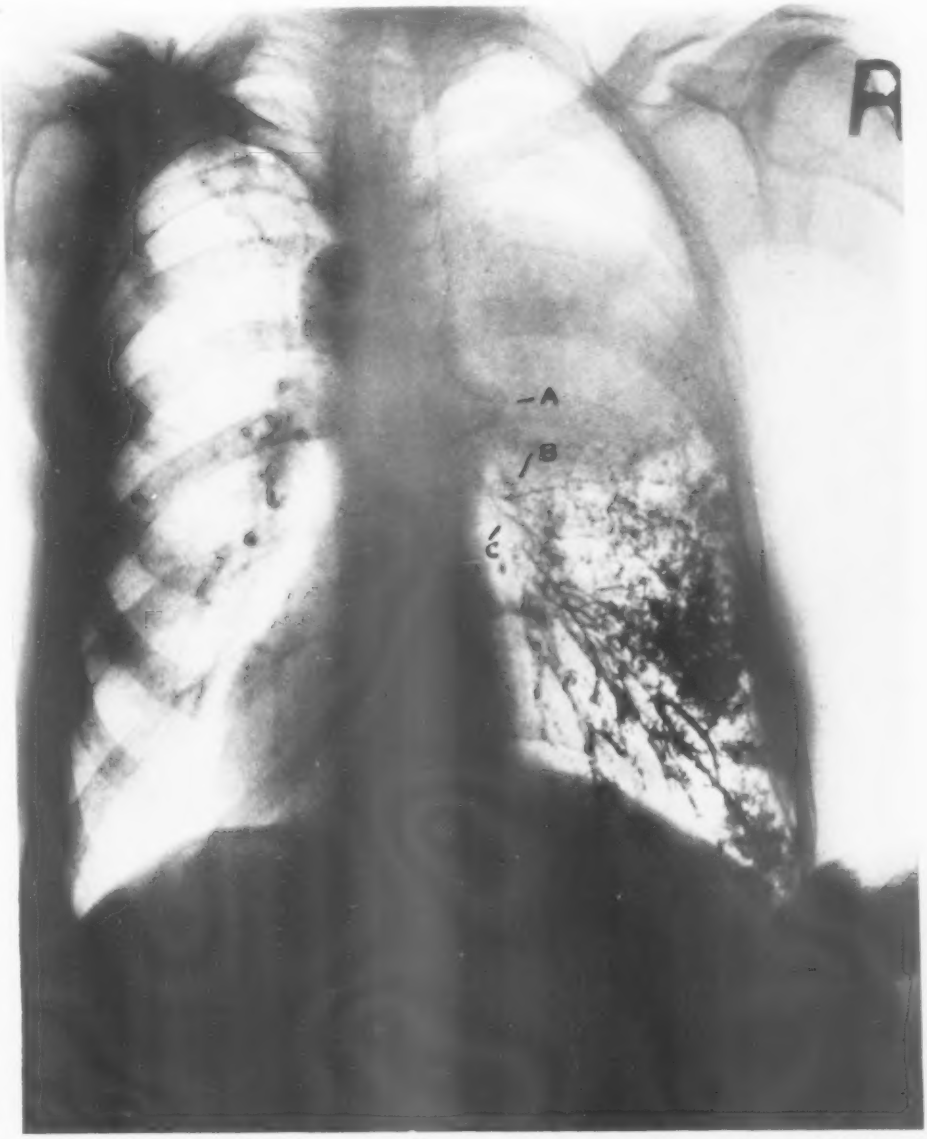

FIG. 14. Posteroanterior view of the same case as Figure 13, showing the obstructed upper lobe bronchus, A, the right middle lobe bronchus coming off at B, and the lower lobe bronchus dividing at C. The shadows of the middle and the lower lobe bronchus divisions overlap in the flat film. The abscess shadow has been partially blocked out in the reproduction in order to show the bronchi. Lipiodol injection by Dr. Gabriel Tucker.

apex rises and the posteroanterior view (Fig. 5) how much the apex overlaps the upper lobe posteriorly. These illustrations indicate the impossibility of localizing lesions to the upper lobe or the apex of the much importance in the case of an early tuberculous lesion, except that it might be mistaken for a hilum density, but it becomes of the utmost importance in abscess or a foreign body. By trunk shadow

and lateral view localization, primary tuberculous lesions can now be detected in the apex of the lower lobe. Cavities occurring here are frequently called annular shadows.

The left bronchus leaves the trachea at a more acute angle than the right and passes down under the pulmonary artery and the arch of the aorta by a long sweeping curve (A, Figs. 3 and 4). The left upper lobe bronchus and trunks to the apex of the upper lobe continue this curve around the arch of the aorta toward the left apex.

The left upper lobe bronchus (G, Figs. 3 and 4) or hyparterial bronchus, so-called because it passes below the pulmonary artery, is given off a greater distance away from the spine than is the eparterial bronchus.

The trunks come off from the left upper lobe bronchus and are distributed in very much the same manner as on the right side, except there is a trunk (M, Figs. 3 and 4) going to the lingual tip, or part of the left upper lobe which lies over and to the left of the heart. This trunk comes off from the hyparterial bronchus where it breaks up, and extends forward, outward and downward. It is often obscured by the heart shadow. The smaller branches are not seen.

The left lower lobe bronchus (H, Figs. 3 and 4) is longer than the right lower lobe bronchus but similar in length to the right stem bronchus.

ZONES

For convenience of description of the flat film, the lung below the first rib may be divided into three vertical zones, extending outward from the lateral border of the spinal shadow to the lateral chest wall. The inner zone contains the root or hilum shadows. The middle zone contains the trunk shadows, gradually fading out into their final subdivisions. The peripheral zone contains radiating lines or linear markings from the ultimate trunk shadows and gradually fading away in their final divisions before the periphery is quite reached.

Such a division into zones does not apply to stereoscopic films for the reason that the zones cannot be limited by single lines because they extend around the periphery of the entire lung or lobe. Stereoscopically one thinks of these zones more as layers. These are more applicable in connection with the upper lobes, in which the inner zone is occupied by the hilum, the trunk shadows occupy the middle zone and the linear markings occupy the outer, peripheral or pleural zone, and extend almost but not quite to the periphery or pleura. Roughly, these three zones represent the three thirds of thickness. The linear markings of the vertebral trunks are largely confined to the circle formed by the first rib. Those of the first interspace trunks are seen mostly behind the first interspace in front and in front of the third and fourth interspaces behind. The linear markings from the second interspace trunks are visualized behind the second and third interspaces in front, above the fifth rib laterally and in front of the fifth interspace, and sometimes the sixth, posteriorly.

CALCIFICATIONS

Calcifications were almost universally noted in one or both hila (Fig. 1) by two of the three members of the roentgen group and not so frequently by the third member. Calcifications were occasionally found in the upper lobes and quite frequently along the heavy trunks to the lower lobes. It must be remembered, however, that pulmonary lymph nodes in the lower lobes extend much further along the subdivisions of the bronchi than in the other lobes, so that calcified nodes here have probably no more significance than in the hilum. This matter seemed so important that Drs. Opie and McPhedran of the Henry Phipps Institute were asked to discuss the matter from the pathological and roentgenological standpoints, as to the significance of calcifications and their proven frequency.

Drs. Opie and McPhedran called attention to the fact that in roentgenograms of children's chests, the frequency of calcified nodules within the lungs is usually overestimated. Sharply defined round shadows *suggesting* calcified nodules were found in almost every roentgenogram, but many of these were referable to vascular trunks directed in the axis of the rays. Dr. McPhedran has found that rotation of the patient slightly will cause their disappear-

ance. When these shadows are excluded, calcified lesions of both lungs and lymph nodes may be identified with considerable accuracy. Many are probably missed in the posteroanterior view, being overshadowed by the heart and spine.

They found at the Phipps Institute that calcified tuberculous lesions increased with age and were more numerous in children of families in which some member suffered with open tuberculosis than in families with no tuberculosis. In children exposed to open tuberculosis there was a gradually progressive increase in recognizable calcified lesions from

11.1 per cent from birth to 5 years to
70.6 per cent from 15 years to 20 years.

In non-contact cases the figures were 0 per cent and 33.3 per cent respectively.

In children, tracheobronchial lymph nodes with sufficient calcification to make them conspicuous in roentgenograms may be accompanied by progressive tuberculosis. In adults, calcified tracheobronchial lymph nodes are less significant, for in most instances healing has doubtless occurred. At least two members of the roentgen group were of the opinion that cases showing calcified nodules had developed more resistance to tuberculous infection than those without similar calcifications within the lymph nodes at the root of the lung.

Dr. Opie, in a study of excised lungs in 100 children dying from all causes and after roentgenograms had been made, found that calcified lymph nodules in the lungs and hilum were invariably referable to tuberculosis. He has concluded that inflammatory lesions do not cause calcifications in either location. Other forms of calcification are doubtless occasionally encountered, but are so infrequent as to be practically negligible.

THE LATERAL VIEW OF THE CHEST

As more and more dependence is being placed upon the lateral view of the chest for purposes of diagnosis, one member of the roentgen group made an extended study of this view in collaboration with several colleagues. Most roentgenologists have made lateral view studies only in the presence of disease and have not become thoroughly familiar with the normal or healthy chest when viewed in this direction. In fact, their conception of the normal lateral view at this time is comparable to that of the posteroanterior view in the very beginning of their roentgenological work. We feel that this study has been of so much value to us that the imparting of our knowledge cannot fail to be of some value to roentgenologists in general. We strongly urge familiarity with the lateral view of the healthy adult chest as a basis for the recognition of pathology. The following striking observations have been made:

1. *The anterior edge of the heart shadow* is in contact with the anterior chest wall for a variable distance from below upward. The extremes of contact found were from 2 cm. to 11 cm. The average contact was about – cm. It was somewhat less in males than in females (Fig. –), and the least in older males (Figs. 8 and 10), apparently on account of the bowing forward of the sternum, the bowing of the spine and the emphysema or increased aeration of the lingual tip of the left lung.

2. *The heart shadow was found to rest below* upon the superimposed diaphragmatic shadows in some part or all of the anterior half of the latter. In over 50 per cent of individuals it rested upon the anterior two-fifths (Figs. 2 and –).

3. *Attachment of the Pericardium.* Extending downward from the posterior edge of the heart shadow from a point where this edge curves forward to rest upon the superimposed diaphragmatic shadows was found a faint but clearly perceptible shadow, with its posterior border straight or slightly concave, and extending to the superimposed diaphragmatic shadows, or sometimes, visibly to the left diaphragm (Figs. – and 8 and, marked by arrows, Figs. 2 and 10) supposedly attached to the latter at or in front of the middle, and just behind the heart contact point, except in a few instances in which the anteroposterior dimension of the heart was unusually great (Fig. 8).

This shadow seemed at first to be of some importance because it was interpreted

as a backward reflected portion of the pericardial sac passing downward and backward to an attachment to the left diaphragm, and knowing the posterior curve of the heart shadow, it was thought that this might be a vantage point for observing slight pericardial effusions or up and down movements of the diaphragm in obliterative pericarditis. The possible importance of this shadow led to attempts to identify it accurately, and its exact identification seems advisable lest the shadow be mistaken for some structure it does not represent. The benefit of our investigations will be given, therefore.

Anatomists (Gray, Piersol et al.) describe the base of the pericardial sac as firmly attached to the upper surface of the diaphragm through its entire extent over the anterior and a portion of the left lobe of the central tendon. Two of the thickened bands of the fibrous pericardium pass downward and backward from the posterior surface of the pericardium on each side of the inferior vena cava to be attached to the diaphragm. These are known as the right and left phrenopericardial ligaments. No cavity exists normally between the parietal and visceral layers of the pericardium, except that at the periphery of the base of the sac a slight space exists and is occupied normally by a quantity of pericardial fluid.

As a number of pathologists consulted were not familiar with any posterior cul-de-sac of the pericardium at the base, Dr. E. P. Pendergrass and Dr. Max Strumia kindly consented to investigate this region at the autopsy table. They found that where the lower pericardial sac was attached posteriorly to the left diaphragm it was reflected backward about 2 cm. posterior to the postero-inferior aspect of the heart, and the posterior wall of the pericardial sac passed downward and backward to meet this posterior diaphragmatic attachment. This formed a cul-de-sac which would readily admit the finger. The cul-de-sac was narrow laterally, and when the left diaphragm was pushed down, the posterior edge of the cul-de-sac was made prominent, as in the shadow shown in the lateral roentgenogram. This cul-de-sac was a little to the left of the midline, and will not be found in true midline sagittal sections of anatomical specimens. The structures in this region are well shown in Figures 9 and 10 of an article by Fetterolf and Gittings.[1] In the sagittal section (Fig. 9) the plane of section of the body of a new-born child was 0.75 cm. to the left of the midsternal line.

The supposed pericardial attachment shadow as shown in the lateral roentgenogram (Figs. 2, 7, 8 and 10) is too dense to be cast by two thin layers of pericardium alone, even including the phrenopericardial ligaments. It is more dense where uncovered by heart shadow than the thoracic aorta lying posterior to it. It is probable that the shadow is a composite one, made up of the inferior vena cava, the phrenopericardial ligaments and possibly also fluid in the cul-de-sac. It is not likely that the inferior vena cava alone would cast a shadow more dense than that of the descending thoracic aorta. This shadow is practically identical in position, extent and relations in both lateral right and lateral left roentgenograms, except possibly it is a little more dense in the lateral right views, suggesting that it is made up very largely by the inferior vena cava. It does not disappear on expiration, nor change in general direction in the two phases of respiration, showing that it is not due entirely to pericardium reflection put on a stretch. It is much more prominent when the diaphragms descend in full inspiration.

The exact effect, if any, of slight pericardial effusions upon this shadow is unknown. Minor enlargements of the heart pass by or overlap it (Fig. 8). It is hidden by great enlargements and extensive effusions.

4. *The Cardio-spinal Space.* This is the portion of the retrocardiac space between the posterior border of the heart shadow and the anterior aspect of the shadows of the vertebral bodies. It is always clear normally, except for the faint shadow of the descending thoracic aorta just in front of the spine (Fig. 10). The usual shape of this space varies from a vertical rectangle (Fig. 10) to a truncated isos-

[1] Fetterolf, G., and Gittings, J. C. Some anatomic features of the child's thorax and their practical application in physical diagnosis. *Am. J. Dis. Child.*, 1911, i, 6–25.

celes (Figs. 7 and 8) or right angled triangle (Fig. 9). It is considerably lessened in width in enlargement of the right or left ventricles or in pericardial effusions. It is increased in width as the anteroposterior diameter of the chest increases in emphysema or in increased aeration such as is found in athletes (Fig. 9).

5. *Relations of the Domes of the Diaphragms.* The domes may run parallel from before backward (Fig. 2), or may cross, in which case the crossing may be about the midline (Fig. 7), or anterior or posterior (Figs. 8 and 10) to this point. These relative positions may be altered by a large number of conditions, both normal and abnormal, as, for example, varying degrees of abdominal distention, gas in the fundus of the stomach, a high splenic flexure, pleural adhesions or hepatic enlargements. The anterior costophrenic sulcus is negligible, but the posterior sulcus is deep. We found the posterior attachment to be 6 to 8 cm. lower than the anterior in thin individuals (Fig. 2) and about 4 cm. lower in stout persons (Fig. 9). The extreme differences in level found were 1.5 and 12 cm. On deep inspiration the domes become straighter, but the levels of attachment, of course, remain unchanged. Even with the deep posterior costophrenic sulcus it is not likely that free pleural effusions of any extent could remain undetected here in the anteroposterior view, as they would have to extend laterally to some extent and obliterate the lateral costophrenic sulcus. Small loculated posterior effusions, however, can lie in the posterior sulcus and not be observed in the anteroposterior view.

6. *Bronchial Levels.* The right bronchus was found invariably anterior to the left. This is the best view to observe deformities such as stenoses of the trachea and the right and left bronchi.

7. In the chests of older adults showing a tendency toward emphysema (Fig. 10) and in athletes (Fig. 9) with unusual lung capacity, the anteroposterior diameter of the chest is decidedly increased and the cardiospinal space is increased. In emphysematous chests the upper portion is further increased in the anteroposterior dimension by forward bowing of the sternum and often by a broad regular kyphosis. The former increases the sternoaortic space (Fig. 10).

8. The lateral view is a good one to note widening of the aorta. In older adults the space between the ascending and descending arches increases (Fig. 10). This proves that one must be all the more careful to make posteroanterior views without any inclination of the patient, or otherwise the aortic shadow is more likely to be made to appear wider than it should appear. Inspection of a lateral roentgenogram which shows the aortic arch well (Fig. 10), and comparison with the aortic shadow in a posteroanterior view convince one that it is improper to speak of the *transverse* arch of the aorta. It would certainly be much more accurate to designate this portion as the *horizontal* arch, as suggested to us by Dr. George Fetterolf, because it passes almost directly backward.

9. The lateral view will frequently demonstrate interlobar pleural thickening or slight effusions that are scarcely noticeable or not visible in the posteroanterior direction (Fig. 12).

INFECTIOUS OSTEOMYELITIS: DIFFERENTIAL DIAGNOSIS*

BY RALPH S. BROMER, M.D.

Roentgenologist to the Episcopal, Children's and Orthopaedic Hospitals

PHILADELPHIA, PENNSYLVANIA

THE interpretation of roentgenograms depends, to a large extent, upon the degree of knowledge possessed by the interpreter of the pathological changes which are shown on the roentgenograms. Lovett and Wolbach[1] have pointed out that pathological conditions in bone give rise to only three processes: that of (1) bone proliferation and new bone formation; (2) rarefaction or bone destruction, and (3) bone atrophy or loss of calcium salts. The rarefaction may be limited or widespread, the bone production may be confined to the bone itself, or, as in the malignant lesions, it may invade the surrounding tissues. In some instances cysts may develop in bone and they may be caused by a variety of diseases. It is very unusual for only one of these processes to be present, but often combination of only two of them may result. Long since, a definite conformation and appearance of these pathological changes on the roentgenogram have been described as typical of infectious or pyogenic osteomyelitis and have served as the criteria of differentiation from other diseases.

But there have arisen in the study of this disease, as of any other, variant or transitional types of roentgenographic changes which are very difficult to recognize and differentiate from other disease types and indeed at times they may even more resemble the accepted typical picture of some other disease than of osteomyelitis itself. The illustration and study of these types is the excuse for the presentation of this paper.

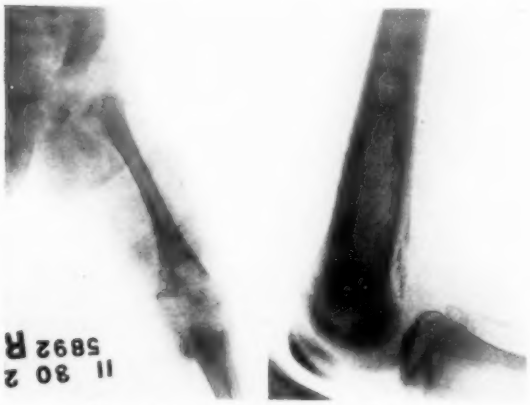

FIG. 1.

FIG. 2.

FIG. 1. Osteomyelitis. Areas of rarefaction in the distal extremity of the shaft and the lower epiphysis of the femur. Culture of pus obtained at operation, *Streptococcus hemolyticus*. The absence of atrophy of the shaft and the comparatively short duration of symptoms prior to roentgen examination aid in the differentiation from tuberculosis.

FIG. 2. Large Brodie's abscess of femur. Culture of pus, *Staphylococcus aureus*. Well-marked periosteal reaction.

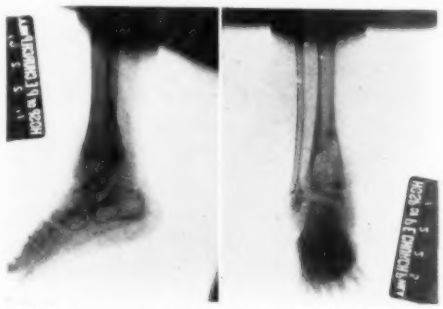

FIG. 3. Wedge-shaped area of rarefaction in the lower extremity of the diaphysis of the tibia. Duration two years previous to roentgen examination. At operation the periosteum was found to be slightly thickened and the cortex was slightly hyperemic. The cortex was about 2 mm. thick, and when this was removed a yellowish white cyst wall bulged into the opening. When this was cut through with scissors, some semi-fluid matter resembling tuberculous pus, oozed out, and then considerable cheesy matter was evacuated, but no free fluid. The cyst cavity extended down to the epiphyseal cartilage. Culture and smear from the cyst were negative. The cyst wall and contents did not reach the laboratory in fit condition for histologic study or for inoculation into guinea pigs.

In approaching the subject of cystic disease of bone which may be caused by a variety of pathological conditions, Ashhurst, Bromer and White[2] have classified

* Read before the Section on Radiology at the Seventy-seventh Annual Session of the American Medical Association, Dallas, Texas, April, 1926.

all diseases of bone under three general categories: Infections, dystrophies and tumors. It has seemed best to approach the differential diagnosis of pyogenic osteomyelitis in the same manner, illustrating first, cases of other infections with which it may be confused, then cases of tumors and then of dystrophies.

Of the infections no definition is necessary. Syphilis and tuberculosis are the two most likely to cause confusion. Ashhurst[2] defined the dystrophies as (1) remote or extremely attenuated infections, from which no causative organism can be obtained, or (2) as alterations or congenital abnormalities of metabolism, whose true cause may or may not be determined. The term tumor was used in the clinical sense, inasmuch as the pathologic and pathogenic sense of the term is still in dispute. A tumor may be an embryonal (malignant) type, an intermediary (questionable) type, or an adult (benign) type, there being thus many tumors which as Ewing says are "neither benign or malignant." There are also many tumors which are neither true granulation tissue (inflammatory reaction) nor yet true tumors. It is this transition from inflammatory reaction to true tumor growth which makes the differential diagnosis of many lesions not only difficult but almost impossible both for the roentgenologist and the pathologist.

GROUP 1. INFECTIONS

Pyogenic infections of bone cause, first, destruction of bone followed by repair, the destruction predominating in the acute stage before systemic reaction is sufficient to start reparative and formative changes. The destruction means necrosis of bone, the formation of sequestra with new bone or involucrum surrounding the individual sequestrum. When this proceeds in the normal manner it gives the clinical roentgen picture by which pyogenic osteomyelitis is diagnosed and differentiated on the roentgenogram. But often instead of sequestration there is hardening and thickening of bone with a comparatively small central area of destruction. These cases take the form of Brodie's abscess, or Markoe's abscess or the condition described by Garre: merely bone sclerosis without any demonstrable pus or central cavity.

Thus, the usual description of osteomyelitis is first bone destruction followed by repair and new bone formation. Tuberculosis is regarded as usually destructive, occurring near the epiphysis (Fig. 1) and characterized by marked atrophy of the shaft of the affected bone, and syphilis is

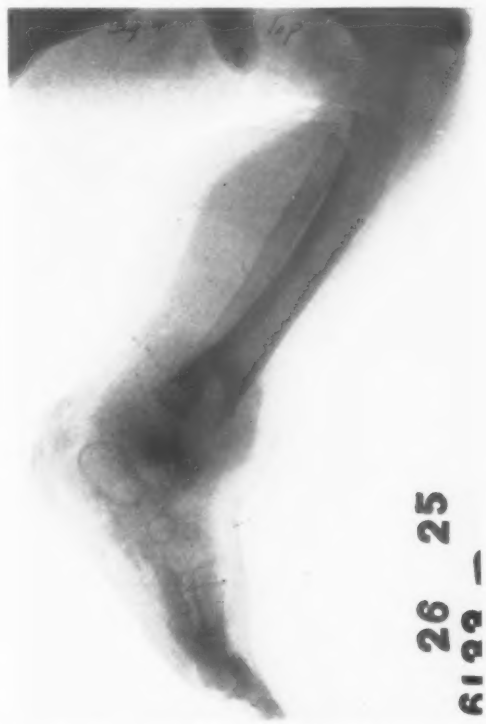

FIG. 4. Osteomyelitis. Culture of pneumococcus obtained from pus at operation. Smears of pus negative for tubercle bacilli. The rarefied area in the lower end of the diaphysis of the tibia is wedge shaped with the base toward the epiphyseal line, surrounded on the side of the shaft by increased density and inflammatory reaction. Moderate involvement of the periosteum.

considered as largely formative or proliferative, with comparatively little or no bone destruction.

Tuberculosis. Tuberculosis and pyogenic osteomyelitis can produce similar roentgen appearances. According to Lovett and Wolbach,[1] first, the so-called Brodie's abscess (Fig. 2) can be simulated by both diseases. Second, wedge-shaped areas of rarefied bone (Figs. 3 and 4) with varied degrees of cortical thickening, with their bases toward the articular extremities of

the bones can be found in both conditions. Third, they make mention of the occurrence of tuberculosis of the shaft resulting in a picture very much like that of osteomyelitis. There are probably more case reports of such occurrence in Continental and English journals than in the American. Brown and Stiefel[3] have reported one case with a roentgen appearance of the multiple roentgenograms resemble osteomyelitis. Allison and Fisher[4] were able to produce tuberculosis experimentally in any portion of the long bones of dogs. They found that when the focus was implanted under the periosteum or in the diaphysis, a proliferative process, resulting in the formation of new bone, occurred. When the epiphysis or the joint surface was inoculated this reac-

FIG. 5. Pyogenic osteomyelitis and arthritis of the hip joint in which the infection was primary in the shaft. A portion of the epiphysis of the head of the femur has become sequestrated. The joint space is decreased in width owing to the destruction of the joint cartilage. There is marked atrophy of the shaft of the femur resembling that found in many cases of tuberculous arthritis. Culture of pus obtained at operation, *Staphylococcus aureus*.

lesions which made a differential diagnosis between syphilis and tuberculosis very difficult. At no time, however, was the diagnosis of osteomyelitis of pyogenic origin considered a possibility. The diagnosis of tuberculosis was verified by pathological and autopsy findings. Three of the cases reported by Lovett and Wolbach had definite involvement of shaft with little or no extension to the epiphyseal line, and the tion did not occur. This observation seemed to bear out the clinical classification of John Fraser (Tuberculosis of Bone and Joints, 1914) in that he described a hypertrophic type of bone tuberculosis which occurs in the shaft of long bones. In six years at the Episcopal, Children's and Orthopaedic Hospitals only one case of this type of tuberculous involvement has been noted, and because of the rarity of

this occurrence a full report of this case is appended.

Phemister[5] has recently called attention to the differential diagnosis of pyogenic and tuberculous arthritis. He points out that pyogenic arthritis quickly destroys cartilage, and, if the infection is severe, the articular cortex on joint surfaces where weight bearing is exerted. In tuberculous arthritis the cartilage has a tendency to remain intact for a long time between weight bearing surfaces and it is destroyed first by the direct attack of granulation tissue along the free surfaces. It stands longest in the regions of contact and greatest pressure in the joint. Consequently the joint cleft or clear space between articulating bones on the roentgenogram is preserved for a longer time in tuberculous arthritis. He further states that secondary invasion of the bone resulting in sequestra bordering on the articular surface is rare in primary pyogenic arthritis, but is common as a late occurrence in tuberculous arthritis. However, if the pyogenic infection is primary in the shaft and later extends into the epiphysis and the joint, necrosis and sequestration bordering on the joint sometimes takes place. This might lead to a picture that could easily be confused with cases of tuberculous arthritis in which sequestration bordering on the joint has occurred. In two or three weeks' time the cartilage in these pyogenic cases is often destroyed by proteolytic action of the pus, hence there should be a diminution of the width of the joint cleft and this should be of assistance in making the diagnosis.

FIG. 6. Aged six weeks. Blood Wassermann negative; von Pirquet negative. Pus from abscess at operation, staphylococcus. Two small sequestra can be seen, otherwise the roentgenogram resembles syphilis.

FIG. 7. Aged four months. Congenital syphilis involving the periosteum of the distal extremity of the diaphysis of the humerus with preservation of the epiphysis of the capitellum. The usual type of joint lesion in syphilis. Multiple lesions. Blood Wassermann: cholesterin, positive, four plus; acetone, positive, four plus.

Another point of aid should be the comparatively early appearance of the sequestrum in osteomyelitis in contrast to the late appearance in tuberculosis (Fig. 5).

As a result of the study of the cases of this series the commonly accepted sign of atrophy of the affected bone, with perhaps atrophy of contiguous bones of the affected limb, can still be regarded as a fairly constant finding in many cases of tuberculosis. Likewise the statement of Codman[6] that in the early stages of tuberculosis in children the centers of ossification of the

affected epiphyses are enlarged and rectangular instead of pyramidal, can also be so regarded. This has been called the "squaring of the epiphyses."

FIG. 8. Periosteal sarcoma of the tibia, erroneously diagnosed at first as acute osteomyelitis. Symptoms first noted following traumatism to leg, three weeks before this roentgen examination. Eight weeks later, examination showed perpendicular striations and an appearance typical of a periosteal sarcoma.

Syphilis. According to Lovett and Wolbach,[1] syphilis affects bone in two ways: (1) There are local, rapidly formed gummatous lesions causing destruction of bone. They may be endosteal or periosteal or perivascular and they may extend into the cortex and medullary canal. (2) Syphilis may only slightly affect the periosteum and endosteum and as a result of developing osteoblasts, new bone is formed. In the first way, the bone is choked by the gummatous process and in the second, there is

only stimulation of bone forming tissue and the result is in the main a proliferative and formative process.

Wilhelm[7] in his work on the differentiation of syphilis and osteitis fibrosa states that all congenital and acquired syphilitic changes of bone are the result of two fundamental processes going on simultaneously: First, the destruction of bone substance by syphilitic granulation tissue and second, the new formation of bone. Added to this are changes due to complicating infiltrative and ulcerative processes in the overlying soft parts, occurring in superficial bone lesions, together with secondary reparative formation of new bone around gummata. As a result, many variations are seen in the roentgenological picture of bone and joint syphilis.

The proliferative or hyperostotic form of syphilis, as he calls it, shows (1) marked periosteal involvement and participation in the new bone formation; (2) more or less narrowing of the medullary canal, and (3) new bone laid down parallel to the long axis of the shaft. All roentgenologists will agree that these changes can be seen in the chronic form of osteomyelitis when the process has become almost, if not completely, a formative one. In these cases dependence must be placed on the history, the Wassermann reaction and sometimes on the therapeutic test. A fusiform shape of the shaft can occur in both conditions.

Again, it has been the experience of many to see the early periosteal change in young adults which cannot be differentiated by the roentgen ray alone. An acute pyogenic periostitis will often resemble that of syphilis and the symptoms of acute inflammation may not be marked. Baetjer and Waters[5] believe that if the lesions are multiple, accompanied by an osteitis without a cavity, the lesion is most likely to be syphilis. They describe the "lace work" type of periostitis in which the calcium salts are laid down perpendicular to the shaft, extending in a band about a quarter of an inch from the shaft, often for half its length or more, and regard this as invariably syphilitic in origin. But this type is not often encountered. Their main reliance on differentiation is the fact that extensive bone destruction is not accompanied by the symptoms of inflammation which would naturally occur if the changes were due to an acute infection.

In the congenital syphilis which is so often a joint lesion, experience in the cases studied at the Children's Hospital has shown that in almost all cases with joint lesions the characteristics usually described as typical of this condition were found, namely, the presence of a well-developed periostitis, the preservation of the joint without cartilaginous change, and the occurrence in the first few years of life. Single lesions have been encountered as often as multiple. Baetjer and Waters state

FIG. 9. Chronic osteomyelitis. Duration thirteen months previous to roentgen examination. Culture from operative wound, *Staphylococcus aureus*. Blood Wassermann, twice negative. Pathological diagnosis: chronic suppurative osteomyelitis with fibrous tissue. Guinea pig inoculation, negative. Perpendicular striations and sequestra are present.

that rarefied, punched out areas are often seen in the diaphyseal ends. These areas should not be confused with rarefied areas sometimes seen in osteomyelitis situated near the diaphyseal ends (Figs. 6 and 7). In cases of early osteomyelitis the clinical history has helped to differentiate it from syphilis. Granting that tuberculosis of the shaft does occur, its differentiation from syphilis seems to be a more difficult matter than the differentiation of osteomyelitis from syphilis.

FIG. 10. Chronic osteomyelitis. Duration thirteen months previous to roentgen examination. Culture from operative wound, *Staphylococcus aureus*. Blood Wassermann, twice negative. Pathological diagnosis: chronic suppurative osteomyelitis with fibrous tissue. Guinea pig inoculation, negative. Perpendicular striations and sequestra are present.

GROUP 2. TUMORS

Probably the two most likely tumors with which osteomyelitis might be confused are certain types of osteogenic sarcoma and endothelioma of bone (Ewing's tumor). Occasionally the early destructive stage of osteomyelitis might resemble a metastatic carcinoma of bone when it occurs in a patient of the age in which carcinoma is most often seen.

There are two types of osteogenic sarcoma which might be difficult to differentiate from osteomyelitis, the first is the very early case of the type formerly spoken of as periosteal sarcoma. Here the term periosteal sarcoma will be used in its older sense, inasmuch as it was previously so called to the exclusion of any other name, before the new nomenclature of the Bone Registry made its appearance. At no time will it be used to designate the fibrosarcoma, juxta-periosteal, as is the case in the nomenclature of the Registry, for which Ashhurst prefers the old name parosteal as being more definitive. In its well-developed stages, the periosteal (osteogenic) sarcoma should not be mistaken for osteomyelitis, but in its early stage (Fig. 8) when practically the only sign is bone destruction with invasion of the cortex, with no demonstrable invasion of the surrounding soft parts, the picture is very likely to be confusing. Of diagnostic aid is

the point of differentiation made by Baetjer, i.e., osteomyelitis has a tendency to destroy cortex in somewhat scattered areas, sarcoma tends to destroy it *en masse* with no intervening scattered areas of normal cortex. The well-known perpendicular striations of new bone growth cannot always be found in the early stage and characteristic "sun ray" form is sometimes entirely lacking.

Indeed it seems that absolute dependence cannot be placed on the sign of new bone laid down perpendicular to the shaft. In two of the cases of osteomyelitis of this series such striations are present. In the first (Figs. 9 and 10) the clinical history quite definitely established the diagnosis; in the second, no absolute diagnosis could be made before operation.

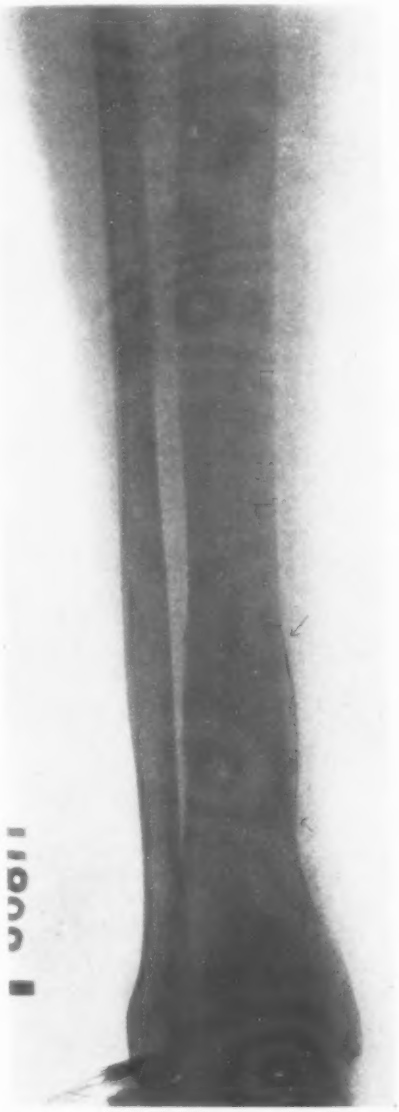

FIG. 11. Osteomyelitis, four weeks after incision of periosteum without drainage for relief of pain, no pus having been found. Small fine perpendicular striations are present. On the day following this roentgen examination pus was obtained from a deep bone abscess from which a culture of staphylococcus was obtained. Blood Wassermann, negative.

FIG. 12. Acute osteomyelitis. The process is entirely destructive, with a pathological fracture. The roentgen appearance resembles metastatic carcinoma. Severe infection of the hand six weeks previous. Because of this definite clinical history there was no difficulty in differential diagnosis.

The second case (Fig. 11) was that of an adult, aged thirty-nine, with a history of deep bone pain in the lower third of the right tibia for three weeks previous to the first roentgen examination. The elevation of temperature never exceeded 100°, rarely reaching that point. There was a history of perinephric abscess six years previous, and of a nasal accessory sinus infection, six months previous. The first

roentgenogram showed a fusiform periosteal and cortical enlargement very suggestive of syphilis. The Wassermann reaction was negative. A simple incision was made cutting down merely through the periosteum (the intention being to so relieve the deep bone pain) and was closed under aseptic precautions. No pus was encountered. The severe pain persisted

The second type is that of the so-called sclerosing type of bone sarcoma. When the tumor has produced dense bone it can resemble the chronic type of osteomyelitis without sequestration. Sometimes these may show a variable amount of periosteal proliferation. Codman regards this diagnosis as rather easy.

When a lesion presenting periosteal

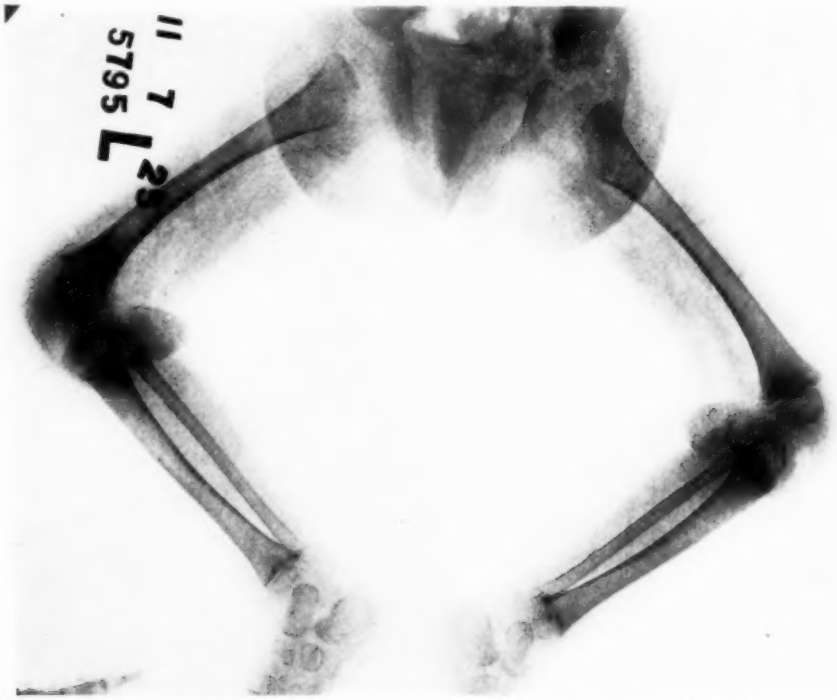

FIG. 13. Illustrates the changes of early scurvy: the dense rings surrounding the epiphyses, the ground glass atrophy of the shafts, the dense lines at the diaphyseal ends. The "scurvy line" is as yet scarcely defined.

with no more elevation of temperature than previous to the operation, and four weeks later another roentgen examination showed the same fusiform swelling with definite perpendicular striations. Exploratory operation, using an Esmarch bandage above the knee as a precautionary measure, exposed a deep collection of pus within the cortex and medullary cavity from which a culture of staphylococcus was obtained. The question naturally arises, did the first operation, having been surgical interference with the periosteum, give rise to these striations? Against this supposition is the fact that syphilis also has been known to produce the same change (Pancoast, verbal communication) (Baetjer and Waters).

change on the roentgenogram is seen, it is well to recall Bloodgood's[9] classification of periostitis in order to include all possible causes.

1. Traumatic ossifying periostitis.
2. Syphilitic ossifying periostitis.
3. Pyogenic ossifying periostitis (associated with osteomyelitis).
4. Ossifying periostitis about tuberculous lesions of bone.
5. Ossifying periostitis associated with benign tumors of bone.

In syphilitic ossifying periostitis he states that if lesions are multiple, sarcoma can be excluded. The Wassermann reaction and specific treatment will establish the diagnosis. In pyogenic ossifying perios-

titis it is rare to see the periosteum affected without cortical change except in the case of gonorrheal infections usually found in the os calcis. Multiplicity of lesions of course aids in the diagnosis of osteomyelitis. Bloodgood has had no cases of tuberculous involvement of the bone previously diagnosed as sarcoma.

Ewing's Tumor. Solitary diffuse endothelioma of bone has been mistaken for osteomyelitis. Ewing[10] states that this is a relatively frequent and quite specific disease which has often been unrecognized and has passed for round cell sarcoma of bone. It seems best to give his own description of this condition.

"Most of the cases that I have seen have been in young subjects, 3 of them 14 years of age, the oldest 19 years. The disease begins without assignable cause, with attacks of pain aggravated by exercise, but not very severe, so that the patient is able to go about for weeks or months. A spontaneous fracture may occur early. A diffuse swelling slowly forms over the affected bone, and a tumor tissue involves the soft parts. Fluctuations in the size of the tumor may then be noted. The growth is comparatively slow, several months elapsing before the external swelling demands attention. At this time the radiograph shows a smooth diffuse rarefaction of a large portion of the shaft of the long bone, the outlines of which are widened. The location in the shaft rather than at the end of the bone and the absence of bone production, distinguishes the condition from solid osteogenic sarcoma, while the failure of early and sharply limited bone destruction is contrasted with the radiograph of telangiectatic bone sarcoma."

He makes no mention of the confusion of this disease with osteomyelitis but instances of this sort have occurred, and these tumors have been excised for diagnosis or treatment and have even been treated for a considerable length of time as osteomyelitis. They respond rapidly to roentgen-ray and radium treatment but the ultimate outcome is fatal. This regression under irradiation can be of diagnostic assistance. Codman[11] emphasizes the fact that this tumor may be multiple, that it shows a characteristic longitudinal striation and that it involves more than half the shaft. It does not produce radiating spicules but produces onion-like layers of periosteal new bone formation such as seen in osteomyelitis. He also states that the roentgenological appearance is usually confused with osteomyelitis. It is an invasive bone destroying tumor but can produce reactive new bone growth as does bacterial infection.

No instances of this tumor have been studied for this work as none have occurred in six years on any of the services of the Episcopal, Orthopaedic or Children's Hospitals. This, however, should not be regarded as evidence of the infrequency of this disease. The possibility of its occurrence must always be remembered and especial effort made not to pass upon it as an osteomyelitis.

FIG. 14. Chronic osteomyelitis. First symptoms were noted two years before roentgen examination. No pus found at operation, only hemorrhagic fluid. Culture from this fluid showed *Staphylococcus aureus*. Pathological diagnosis of bone tissue removed at operation, chronic inflammatory tissue. The inflammatory zone of increased density surrounding the rarefied area and the poorly defined sequestrum are points of differential diagnosis from cystic osteitis.

Metatastic Carcinoma. Occasionally during the rarefied, early stage of osteomyelitis with a very ragged appearance of the perios-

teum the appearance may resemble that of metastatic carcinoma. In the one case of osteomyelitis in this series presenting such change with a pathological fracture the diagnosis was made certain by the history of previous severe infection of the hand and forearm, the lesion occurring in the upper third of the humerus. It would seem that in all cases, even if the roentgen picture of a fretful, miserable child with swollen sometimes reddened joint, marked pain and tenderness on movement and elevation of temperature, is apt to be confusing. The roentgen ray can be of great service in diagnosis. If it is osteomyelitis in the very early stage there will most likely be no demonstrable bone changes on the roentgenogram. If it is a later stage, periosteal change with some rarefaction and destruction of the cortex may be found. In all cases in making this diagnosis, the early changes of scurvy must be sought. As Pelkan has shown, it is not necessary that subperiosteal hemorrhage be present to make the diagnosis of scorbutus. In the early stage, the one most likely to be confused with osteomyelitis, the following are the roentgenographic

FIG. 15.

FIG. 16.

FIGS. 15 and 16. Marked periosteal proliferation of the middle third of the shaft of the left femur. Blood and spinal fluid Wassermann twice negative. Disseminated tuberculosis found at autopsy. No pathological sections were cut from the involved portion of the femur and the diagnosis of tuberculosis of the shaft thus had no absolute verification.

changes are deceptive, the two diseases should not be confounded because of the history and clinical signs and symptoms (Fig. 12).

GROUP 3. DYSTROPHIES

The necessity for differential diagnosis between infantile scurvy and the early stage of acute osteomyelitis and epiphysitis is by no means infrequent. The clinical

signs which establish the diagnosis: (1) The dense ring-like shadow of the calcified matrix of the border of the epiphysis with the smooth ground glass appearance of its center (Wimberger[12]); (2) the smooth ground glass appearance of the shaft of the affected bone; (3) the calcified matrix of the distal end of the diaphysis, i.e., the epiphyseal line. (4) If the disease is more advanced there will be found the rarefied area either just above or below the calcified epiphyseal line, called by Pelkan[13] "the scurvy line." These last two signs have been indiscriminately spoken of as the "white line" of scurvy and the Trümmerfoldzone or the Trümmerzone. The white line (calcified epiphyseal line) has been proven not to be pathognomonic of scurvy (Lovett[14]), but Pelkan claims the "scurvy line" can be so considered. Finally, the last sign (5) can be looked for, the so-called spurs, projections extending outward at the diaphyseal ends which are the first signs of subperiosteal hemorrhage and are due to the shoving out of the zone of preparatory calcification which is greatly weakened in scurvy. Superadded trauma will easily produce epiphyseal separations, another diagnostic point. Since some of these signs will always be found in combination of at least two or more, this differential diagnosis can be considered a rather easy task (Fig. 13).

Osteitis Fibrosa Cystica. Due to the fact that osteomyelitis can cause changes in bone simulating the appearance of bone cysts and due to the fact that occasionally these rarefied cystic areas may be multiple in character, difficulty may arise in its differentiation from the disease entity known as osteitis fibrosa cystica, or chronic cystic osteitis. Under this head will be considered both localized cystic disease and also the general type usually coupled with the name of von Recklinghausen. According to Ashhurst's classification, cysts due to infections were discussed under the first group. If the inflammatory theory of the causation of this condition is accepted then it, too, should have been there discussed. The theory, however, of metabolic disturbance as the cause of von Recklinghausen's disease has never been disproved, and it has seemed more logical to place both the localized and general types under the head of dystrophies, inasmuch as, in general, the pathologic characteristics of each are very similar. It should be added, however, that to the three primary pathological bone manifestations in all diseases of bone, a fourth might be added for this disease, that of fibrous tissue substitution. The areas of lessened density are caused in part by the replacement of osseous tissue by fibrous tissue growth.

Localized chronic cystic osteitis probably occurs more often in the growing periods of life, but two of the cases studied in this series occurred during the third decade. The usual sites for its appearance are the proximal ends of the femur, humerus and fibula, but cysts of the middle third of the shaft are by no means rare. The cortex is intact and has a tendency to expand in a fusiform or cylindrical manner. The area of rarefaction is sharply limited and has a definite outline showing no invasion of the soft tissues. Cystic areas of osteomyelitis, on the other hand, are apt to have inflammatory thickening of the cortex and periosteum in the neighboring areas. A thorough search should always be made for any signs of a sequestrum. In osteomyelitis trabeculations are usually absent while in cystic disease they are often present.

It is possible too, that transitional types can exist in the histological picture. Thus some areas in bone cysts which do not have the usual inner fibrous tissue lining may have the appearance of the inflammatory tissue that results from infection by the usual bacterial agents. In osteomyelitis due to an extremely attenuated and chronic bacterial infection there may be no pus within the cystic cavity, but instead only a hemorrhagic content (Fig. 14). In addition, on the roentgenogram the inflammatory zone of increased density may be slight or almost entirely absent. In progressing a step further in like fashion, there are transitional types grading from the bone cyst to the giant cell tumor, due to the presence of a greater number of the epulis type of foreign body giant cells, resulting in a more or less confusing appearance on the microscopic slide. In some of these cases it is absolutely impossible to differ-

entiate a bone cyst from a giant cell tumor by the roentgenogram. The ultimate dependence in the differentiation between cystic change in osteomyelitis and chronic cystic osteitis is upon the extent of evidence of inflammatory manifestations: thickened cortex, periosteal proliferation and sequestration.

Generalized fibrocystic disease presents a very typical roentgenogram. Several long bones are usually affected, marked deformity due to bowing occurs, and the cortex is expanded and thinned. Within the medullary cavity are large and numerous rarefied areas. The normal bone detail is replaced by irregular strands of trabeculae. Baetjer cites a case with periosteal proliferation. As in osteomyelitis there is sometimes actual lengthening of the bone. It seems that this combined with the clinical picture should give no difficulty in the differential diagnosis. The problem is not so much that of differentiation from osteomyelitis as it is that of differentiation from syphilis.

CONCLUSIONS

When pyogenic osteomyelitis conforms to its usual pathological manifestations, it will produce a roentgenogram which will usually be diagnosed without error.

When it undergoes the destructive stage followed by the proliferative stage, it probably will not be confused with the other infections, syphilis and tuberculosis, especially when it is accompanied by large and well-defined sequestra. Syphilis will be usually formative and tuberculosis will be largely destructive combined with bone atrophy. The chronic stage of osteomyelitis, when the picture is that of a formative process and no evidence of sequestration and involucrum formation can be found, is likely to be confused with syphilis and the differentiation depends largely on the history and the laboratory findings. Tuberculosis of the shaft, although rare in occurrence, will probably only be differentiated by other means than the roentgen ray alone. To the three special forms of manifestations of osteomyelitis and tuberculosis, mentioned by Lovett and Wolbach, which may cause similar roentgen appearances, a fourth (Phemister) is added.

Ewing's tumor or endothelioma of bone is most likely to be confused with osteomyelitis inasmuch as the usual criteria of malignancy are not to be seen (Codman). On the history must be placed most dependence. The early stage of periosteal sarcoma cannot always be differentiated because occasionally in these cases pyrexia, pain and swelling may simulate the signs and symptoms of acute osteomyelitis.

Too much dependence must not be placed on the occurrence of perpendicular striations as a pathognomonic sign of malignancy. These have been noted in cases of both acute osteomyelitis and syphilis.

Of the dystrophies, infantile scurvy will cause no difficulty if its early signs are sought for and found on the roentgenogram. Bone cysts will be differentiated with fair degree of accuracy if the signs of pyogenic inflammatory change are recognized. In cases of osteomyelitis with hemorrhagic content in the rarefied area (abscess) of bone, and with no definite sequestrum, due to attenuated bacterial infection, the diagnosis will sometimes be impossible and can only be made after operation, by other means than the roentgen ray.

Generalized fibrocystic osteitis should not be so difficult to differentiate from osteomyelitis but presents more difficulty in relation to syphilis.

CASE REPORT

Because of the rare occurrence of cases of tuberculosis of the shaft of the bone, the following case is reported in detail. Unfortunately no sections were taken from the portions of the left femur and the left humerus which were shown to be involved on the roentgen examinations, and so no histological diagnosis of tuberculosis of bone was made. The fact that the left femur seemed to be the part first affected clinically, the negative serological reactions for syphilis, and the widespread occurrence of proven tuberculosis in other parts of the body at autopsy would seem to indicate that this was a case of tuberculous infection of the shaft of the bone.

A. H., aged three, male, colored, admitted to the service of Dr. Alfred Hand, Children's Hospital, June 21, 1923.

Past History. Tonsillitis, January, 1923; measles, mild, November, 1923; shingles with fever, March, 1923.

Chief Complaint. Inability to walk, with pain in the left leg especially in the region of the knee.

History of Present Illness. About two weeks before admission began to complain of pain in the left knee. This pain was worse during the morning and disappeared toward mid-day and evening.

He soon began to limp on the left leg and the pain became so severe that he grasped furniture to support himself in walking, putting almost all of his weight on the right leg. He was brought to the Out-Patient Dispensary, June, 13, 1923, and his mother was advised to put him to bed for a week. During this time the pain became steadily worse. He now does not move the leg unless absolutely necessary. Movement of the right causes him no pain. Appetite is excellent, no vomiting. He has always had a slight cough.

Physical Examination on Admission. Lungs show no impairment of resonance. No adventitious sounds heard. Breath sounds are vesicular. Inguinal glands are palpable.

Extremities. The left femur is of slightly greater circumference than the right (0.5 cm.) when measured in the middle of the thigh. No limitation of motion in any of the joints. Tenderness elicited on movement of the left hip joint. No shortening in either leg. Left leg is held in moderate abduction and flexion at the hip with moderate flexion of the knee joint.

Reflexes. Babinski sign positive, no Kernig's sign, ankle clonus distinct. Rigidity of the neck present, no tache elicited.

Laboratory Findings. June 21, 1923.—von Pirquet moderately positive beginning in twenty-four hours, wheal and erythemia: present. Control negative. June 21, spinal fluid Wassermann negative. June 28, blood Wassermann negative. July 6, spinal fluid Wassermann negative. September 21, blood Wassermann negative. October 6, spinal fluid, collodial gold test: 0001123554 meningitic curve.

Roentgen Examinations. June 21, 1923, marked periosteal proliferation with slight cortical thickening of the left femur in the middle third of the shaft and of the left humerus, in the lower third especially along the inner border. Very suggestive of syphilis (Figs. 15 and 16). July 19, examination of the lungs shows an increase in hilum and mediastinal density probably due to mediastinal and hilum tuberculosis. October 19, the examination of the dorsal and lumbar spine shows no abnormality. No evidence of tuberculous arthritis.

November 11, 1923—Summary of Progress of Case: Since onset six months ago, the patient has had low irregular fever, 100° F. The pain complained of in the left leg soon subsided. Gastroenteritis with bloody stools occurred one month after admission, but this also subsided. There has been gradual loss of weight, increasing asthenia, and atrophy of the muscles. The patient is mentally below par. Slight exopthalmos of the left eye is now present with a little increased intraocular tension. The cervical glands are palpable. Examination of the lungs shows nothing striking except perhaps slight dullness and harsh breath sounds over the left upper lung posteriorly. Liver and spleen are just palpable. The ankle jerks are hyperactive and equal. Bilateral ankle clonus is present. Babinski, Brudzinski and Kernig's signs are not present.

Clinical Impression: 1. Syphilis in spite of negative serological examinations. 2. Disseminated tuberculosis.

December 2, absent knee jerks; pupils are dilated and unequal. Negative.

December 2, spinal fluid showed many tubercle bacilli, culture for bacteria.

December 5, in the interval since November 18, the child has become progressively worse, asthenia is more marked with increasing loss of weight. Patient died at 8:50 P.M.

AUTOPSY FINDINGS

Pathological Diagnosis: Tuberculous meningitis; tuberculosis involving the mesenteric glands, spleen, the 3d to the 6th dorsal vertebra inclusive, the floor of the middle fossa and anterior fossa of the skull, and the ethmoid sinuses. Small tuberculoma of the dura at the foramen magnum.

Left pleura: Normally smooth, moist and glistening. Behind the parietal pleura is a collection of soft yellow and creamy pus.

Right pleura: Contains about 100 c.c. of dark thin fluid. This apparently comes from an opening in the esophagus. There is a collection of pus along the spinal column back of the parietal pleura at the level of the 5th and 6th dorsal vertebrae.

Small intestine shows tubercles, in several small areas.

Large intestine shows a few tubercles.

Lymphatics: There is considerable enlargement of the mesenteric glands, which are yellow soft and cheesy in appearance. Some are enlarged to a diameter of 3 cm.

Brain and Skull: There are masses of pus over a large area which has eroded the surface

of the bone in the floor of the middle fossa, left side, and the middle part of the anterior fossa extending down into the ethmoid sinuses. The sella turcica is eaten away and is quite deep. Erosion over the highest portions of each parietal bone is present. There is an exudate of fibrinous character over the surface of the entire brain, with a profuse exudate between the pia and the arachnoid, which covers also the pons and the medulla. On the right anterior edge of the foramen magnum is attached a small irregular mass, 1.5 × 0.5 cm.

Spinal Cord and Membranes: The cord itself is normal. Between the dura and the vertebrae from the 2d to the 10th dorsal vertebra is much cheesy, pussy material. Between many of the vertebral borders in the vertebral discs are sinuses filled with pus connecting with the pus found in the left pleural cavity. The surfaces of the 3d to the 6th dorsal vertebrae are quite extensively eroded. The cervical and lumbar vertebrae show no involvement. Bacteriological smears from the pus in the left pleural cavity, skull, meninges, and mesenteric glands show an occasional tubercle bacillus.

Histological Sections. Spleen—certain areas show typical tubercles composed of a necrotic center surrounded by small round cells, endothelioid cells and typical giant cells.

Small Intestine: Shows desquamation, also typical tubercles between the mucous and muscular coats.

Mesenteric Glands: The greater part of the sectioned gland is degenerated and consists of necrotic, granular, poorly staining material. The border surrounding shows numerous typical tubercle bacilli.

Esophagus: The site of rupture shows no evidence of an inflammatory condition. The tissue in this area shows only much degenerated poorly staining material with cells made out only more or less distinctly. No evidence found to show that this was an ante mortem or post mortem rupture, most probably however it was the latter.

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A VALUABLE ROENTGENOGRAPHIC AID IN THE DIAGNOSIS OF INTESTINAL OBSTRUCTION

BY KENNETH S. DAVIS, M.D.

St. Vincent's Hospital

LOS ANGELES, CALIFORNIA

DURING a period of eighteen months a number of patients were admitted to St. Vincent's Hospital with symptoms pointing to an obstruction in the gastrointestinal tract, the site of the obstruction being indeterminate from the clinical and physical findings alone. Naturally it was impossible to do a routine gastrointestinal examination in this type of case, since the emesis was usually severe and the patient too sick for such a rigorous examination.

In many of these cases we found that a 14 × 17 "scout" roentgenogram of the abdomen and pelvis, carefully taken through a Potter-Bucky diaphragm, was all that was necessary to enable us to determine the approximate site of the lesion, due to the fact that the gut above the obstruction was ballooned out with gas. For example, if the obstruction was in the small intestine we found it to be distended; but the colon was either of normal contour or not seen at all (see Fig. 1). On the other hand, an obstruction in the colon gave an entirely different roentgenographic appearance; the colon above the obstructive site being enormously dilated with usually only a moderate distention of the small bowel (Figs. 2 and 4).

We were unable to determine the nature of the obstructing lesion without further study (either a barium enema, or a gastrointestinal examination, depending on the site of the lesion), but this was not done until the patient was convalescent from his emergency intestinal drainage (enterostomy).

In those cases in which the obstruction was only partial, we found our "scout" roentgenograms to be of no particular value, since there was no distention of the bowel above the lesion. Fortunately this type of patient is usually well enough to permit of a more thorough roentgenographic examination and does not require an emergency operation.

The value of this procedure to the surgeon is obvious, for it enables him to make his incision in the correct area and saves him the necessity of a general abdominal exploration to determine the obstructive point, thus reducing the dangers of the operation. Furthermore, the method is so simple and so easily accomplished, that there is no delay in those cases requiring imperative surgery, and the gastrointestinal tract is not filled with barium.

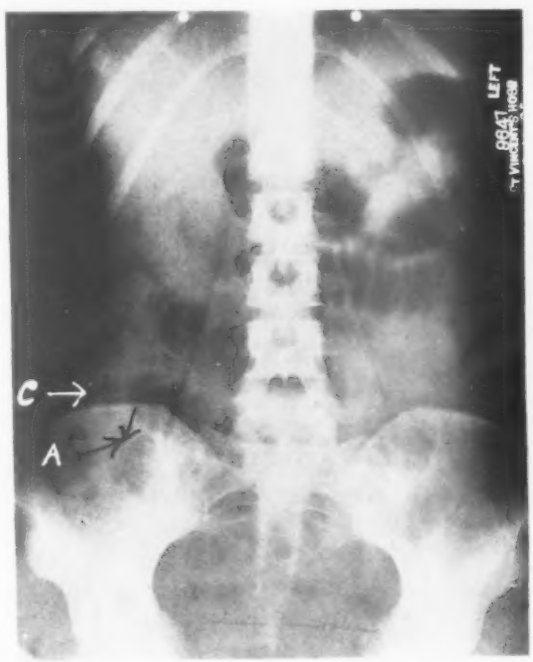

FIG. 1. The "scout" roentgenogram taken in Case 1. Note the dilatation of the small bowel above site A. The colon is not visible, except in the region of the cecum, where there is only a small amount of gas present. The cecum is not dilated. At operation, an obstruction due to an adhesive band was found in the terminal ileum.

ILLUSTRATIVE CASES

CASE 1. A woman, aged thirty, was admitted to the hospital complaining of severe colicky abdominal pains, of about thirty-six hours' duration. These were accompanied by a rather severe nausea and vomiting at the time

of admission. Constipation was almost complete, although the patient had had several bowel movements following enemas, taken the first day of her illness. Patient had a fibroid removed about a year previous, otherwise she had had no abdominal trouble prior to onset of present symptoms. The physical examination was negative, except for a distention of the abdomen and a slight generalized abdominal tenderness and rigidity. Pulse 88, temperature 101°, respiration 22. Leucocyte count 6200.

CASE 11. A woman, aged forty-eight, was brought to the hospital critically ill, with symptoms pointing to an obstruction. Four days prior to admission she had had a sudden attack of severe abdominal cramps which had persisted despite morphine. Since the onset of symptoms, patient had not had a normal bowel movement, although cathartics were taken. Enemas gave fair results at first, with passage of considerable gas as well as feces. Later, however, even these failed to relieve. At the time of admission, emesis was rather severe.

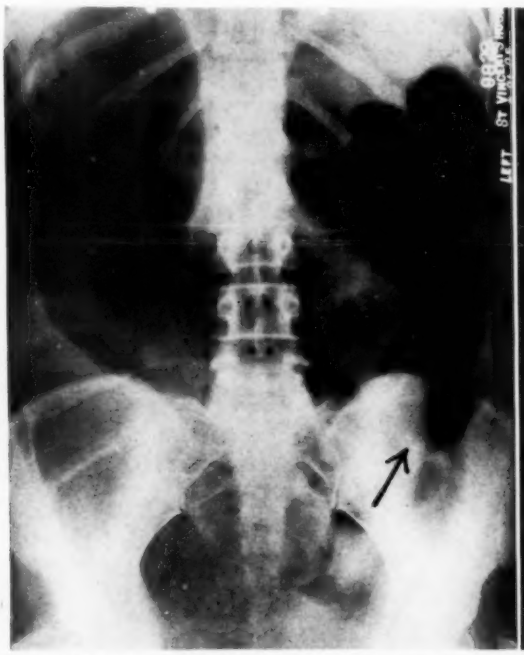

FIG. 2. The "scout" roentgenogram taken in Case 11. Note the enormous distention of the cecum, ascending, transverse and descending colon, by gas. Operative findings in this case were annular carcinoma of the upper sigmoid with complete obstruction.

FIG. 3. The barium enema in Case 11, showing a filling defect in the upper sigmoid, with complete obstruction to the flow of the barium. Note how closely the findings in Figures 2 and 3 coincide. The point of obstruction, as determined by the "scout" roentgenogram, was thought to be in the lower end of the descending colon. In the barium enema it was found to be in the upper end of the sigmoid.

The "scout" roentgenogram of the abdomen and pelvis showed the small bowel distended with gas. I was unable to visualize the colon, except in the region of the cecum, where a small amount of gas was present. The cecum was not dilated (see Fig. 1).

At operation, the small bowel was found to be distended and the entire colon empty. About 4 inches from the ileocecal valve, a thin adhesive band extended from the side of the small bowel down into the pelvis; the loop of the bowel, just proximal to this adhesion, had slipped underneath, completely blocking the intestine. As soon as the small bowel was freed from its adhesions the colon filled with gas. The patient made an uneventful recovery.

The previous history had no bearing on the present complaint, since the patient had never had any intestinal trouble in the past, so far as she knew. Her bowel movements had always been free and regular. The physical examination was negative, except for a symmetrically distended abdomen with generalized rigidity and tenderness. Pulse 100, temperature 99.8°, respiration 22.

The "scout" roentgenogram of the abdomen and pelvis showed an enormous distention of the cecum, ascending, transverse and most of the descending colon, by gas (Fig. 2). An emergency colostomy was performed under a local

anesthetic, which gave immediate relief from the patient's pain and emesis. A week following this, the patient had recovered sufficiently to permit of an examination of the colon with a barium enema. This examination revealed a filling defect of the upper sigmoid, with complete obstruction to the flow of the barium (Fig. 3).

At the second operation, a hard annular tumor was found involving the upper end of the sigmoid, with no adhesions or palpable glands in the mesentery. This was removed and an end to end anastomosis performed. The microscopic diagnosis was adenocarcinoma of the sigmoid.

Case III. A woman, aged forty-seven, came to the hospital complaining of pain in the abdomen, with distention. At the time of admission the patient stated that nothing had passed by bowel for at least four days. She had had similar previous attacks since she was sixteen years of age, but none were as severe as the present attack, and heretofore the obstruction had not been complete. Otherwise her history was negative. On physical examination there was found a distended abdomen, with generalized tenderness, although there was more pain on the left side than on the right. Temperature 98.8°, respiration 30, pulse 100.

The "scout" roentgenogram showed an enormous distention of the cecum, ascending, transverse and the upper part of the descending colon; the splenic flexure showing the most marked dilatation (see Fig. 4).

Laparotomy revealed a congenital malformation of the mesentery of the transverse colon, which was about five times its normal length. At the splenic flexure there was a complete volvulus causing obstruction. The loop of the bowel in the volvulus was so distended with gas and feces that it had interfered with the circulation at the twist of the pedicle, and the bowel was in such condition that resection was necessary. This proved to be too much of a drain on the already weakened condition of the patient, and she died the next day.

COMMENT

A careful scrutiny of the roentgenograms taken in these cases (Figs. 1, 2 and 4), bearing in mind the surgical findings, demonstrates the value of a "scout" roentgenogram in determining the site of obstruction.

Figure 1 is typical of our findings in cases of obstruction in the small bowel.

Figures 2 and 4 show how accurately points of obstruction in the colon can be localized.

Note: Since this paper has been in press, the author has observed a series of cases of obstruction, several of which have added materially to our knowledge of the subject.

A six-day old baby was sent for a "scout" plate to determine point of obstruction, as symptoms of obstruction were definite. From the "scout" plate itself it appeared as if the

Fig. 4. Volvulus of the splenic flexure, with complete obstruction. Note the enormous distention of the cecum, ascending and transverse colon. The gas shadow lying above the transverse colon is the volvulus. It is atypical in appearance for gas in the stomach.

entire colon was enormously distended as well as the small bowel. Fortunately we were given an opportunity to do further study and, by barium enema, found the lower colon extremely narrowed, none of the barium passing above the sigmoid.

At the autopsy a congenital atresia of practically the entire colon was found. Apparently this method is of little value in very young babies, as the small bowel can be distended so enormously that its shadow cannot be differentiated from the shadow of a distended colon.

In 2 cases with partial obstruction in the small bowel, the "scout" roentgenogram failed

to show any evidence of markedly dilated intestine, whereas the six and twenty-four hour motor meal examinations showed one or more loops of moderately distended bowel, the walls being coated with barium as the lumen was filled with gas. Both of these cases were confirmed by laparotomy.

In all of our cases of obstruction in the colon, we have been able to localize the site of the obstruction with a fair degree of accuracy.

THE INFLUENCE OF ROENTGEN RAYS ON WHITE MICE AND THEIR PROGENY

BY MICHAEL LEVINE, PH.D.

Laboratory Division, Montefiore Hospital

NEW YORK CITY

THE question of the effect of roentgen rays on the offspring of irradiated parents is still unsettled. In exposing a large number of white mice to roentgen rays for the purpose of studying the influence of the rays on the reproductive organs of these animals, sterility was frequently observed among them without any other visible effect. Since sterility served as an indication of the efficacy of the roentgen rays, it was considered advisable to test out the doses used in our cancer clinic* on these mice, and to study the effect of the rays on them and their progeny. We bred the progeny of mice which were given sub-sterilizing doses of roentgen rays. We held under observation successive generations of the progeny of male mice that were temporarily sterile as a result of the irradiation. We believe the results of these experiments are of interest in view of the contentions of various workers (see Kupferberg[11]) such as Fraenkel, Halberstädter, Reifferscheid, Unterberger, Schinz, Martius, and others that the offspring of pregnant mothers subject to roentgen-ray treatment for various pathological conditions were physically and mentally abnormal. From the experimental side the data furnished by Bagg,[1] by Little and Bagg,[12] and by their associates, give considerable weight to the importance of this problem in spite of the fact that results obtained with mice under conditions of experimentation are not directly applicable to the human being.

Levine, in a recent paper given before the International Congress of Plant Sciences (1926) reviews the literature on the influence of roentgen rays and radium on animal and plant cells, especially the chromosome behavior. Driessen[7] has reviewed in his study the reports on the effects of roentgen rays on the reproductive cells. In this report I wish to mention such papers as bear only on the question of the effect of roentgen rays on animals and their progeny.

Nürnberger[13] found that young rabbits, mice, and guinea pigs born from roentgen irradiated parents are normal. He also holds that the young brought forth by the young of an irradiated mother are normal. Abortion and sterility, however, are common products of intense irradiation.

Bagg[1] in following up his earlier investigations on the effect of roentgen rays on animal tissue, injected active deposits of radium subcutaneously and intravenously into pregnant white rats. He also used large quantities of radium emanation in these tests. The exposures were made at four periods after mating, varying from seven to eighteen days. In a large number of cases the embryos failed to develop or were aborted.

Embryos were killed by these treatments, Bagg claims. Females irradiated before mating were sterile. Females were irradiated during early stages of preg-

* This refers to one dose given in a course of treatments. Generally our patients were exposed to several doses such as we used, given over different fields.

nancy; the young became absorbed. In several cases, young mice were born with hemorrhagic areas, from females of a group which were treated seven days before mating. Intravenous injections of radium and gamma ray irradiation produced decided changes in the embryo. Changes in the brain and reproductive organs were also observed.

Little and Bagg[12] describe the transmission of two types of eye, foot and leg abnormalities among descendants of roentgen irradiated mice. A divided dose equal to 1 human erythema dose was given the parents. The parents were not visibly affected, although no young were born until ten weeks after the irradiation. Little and Bagg found evidence here for their belief that the germ plasm is influenced by the irradiation and contend that possibly a gene had been affected so as to account for the transmission of these characters. This contention adds another case to the claim made by Guyer and Smith,[5] Stockard,[16] and others that the germ plasm may be modified by external stimuli. Bagg[2] extended his observation to the second and third generation of mice originating from roentgen irradiated parents. Eye defects associated with a club foot observed before were found to persist. Bagg suggests that the eye and foot defects are caused by an arrest in the development of the organ, due to a blood vascular disturbance. In a series of papers, Bagg[2,3,4] advances data on a large number of the progeny of roentgen irradiated parents extending into the sixth generation to show that the absence of a kidney and other visceral abnormalities occur. So far his results have not been corroborated

Snyder[15] in a record of his attempt to induce genetic modification by means of roentgen rays reviews the literature on similar studies made with sensitive sera, heat, cold, alcohol, and roentgen rays. He planned a series of experiments to test out the effects of roentgen rays on the progeny of male rats exposed to various doses. He contends that no abnormalities appeared in the large number of rats studied, nor was there a reduction in vigor or fertility, although temporary sterility was produced.

Unterberger[17] studied the influence of roentgen rays on the progeny of the butterfly *Ocneria dispar L.* He found the offspring produced were two-thirds of the normal size. He also notes that egg production is decreased. The progeny of these animals suffer further reduction in size since they attain one-third to one-half of the normal size for the species.

Hooker[9] in a report on the effect of roentgen rays upon the reproduction of the rat, believes that small doses of roentgen rays stimulate sexual development when applied before sexual maturity. Two erythema doses are sufficient to sterilize the male rat for four months although actively motile sperm cells may be demonstrated. Two erythema doses may retard reproduction in the female but larger doses are more often necessary.*

METHODS AND MATERIALS

The animals used in these experiments consisted of a strain of white mice that had been under our observation for three years before we began our irradiation experiments. The stock at the beginning of this experiment consisted of over 1000 mice which were active and very prolific. A large number of these animals were also used for mouse tumor transplantation experiments and the young of these animals were also under observation. No abnormalities of eye, foot, or viscera were ever observed in these animals.

Young males and females of different parents at the age of four weeks were segregated into large boxes. These were kept here from three to four weeks longer. The animals were then mated, each pair was placed in a wooden box sufficiently large to allow considerable freedom of motion. A removable wire cover was used over each cage.

The irradiation of the animals was accomplished by placing the cage under the roentgen tube. The roentgen tube was confined to a large lead-lined case of wood

* Hooker,[10] in a later study, reports results obtained by subjecting the white rat to three types of roentgen rays, which he describes as feebly penetrating, more penetrating, and most penetrating. Hooker contends that with his three different types of rays used there was evidence of a difference in resistance to irradiation as shown by the reproductive glands. Hooker's results are not constant and he believes that this indicates an extreme difference in individual resistance not hitherto recognized in such studies.

with a window in its bottom, through which the rays were emitted. Two plates of bakelite held parallel to each other by a wooden framework were placed between the cage and the roentgen tube carrier so that the lower plate covered the cage and measured the distance of 50 cm. from the cathode. The upper plate was so made as to permit the insertion of the metal filters. The wire cover on the cage was removed during the exposure. The animals were free to move about in the cage but were held confined therein.

The source of the rays was a Coolidge tube through which a current 3.5 to 4 ma. and a voltage of 155 kv. was passed. Although the distance between the target and lower bakelite plate as mentioned above was 50 cm., the distance between the animals and the target was calculated for a number of animals to be approximately 55 to 57 cm. The rays were filtered through 1 mm. aluminum and 0.5 mm. copper. The entire animal was irradiated. The length of each exposure was thirty minutes. This dose was repeated under the same conditions on consecutive days until one and a half and three hour exposures were made.

SUB-STERILIZING DOSE

Twenty-six pairs of young mice confined in separate boxes such as we described above were kept uniformly with respect to food, light, and air. The daily diet consisted of a cereal mixed with dried scrap, powdered milk and table salt to which 5–10 c.c. of water was added. Twice a week fresh vegetables and whole milk with bread was given. This food was likewise given to all our mice. The animals had reached sexual maturity at the time of mating. The irradiation of 15 pairs began six to eight days after mating, and lasted from the eighth to the tenth day, although the length of each exposure was for only one-half hour each day as mentioned above. In 8 cases the irradiation was started on the twelfth day and fifteenth day after mating, while the remaining pairs were irradiated beginning on the nineteenth day. Five pairs of animals selected at random but of the same age and stock as those used for roentgen treatment were mated in individual boxes and served as controls. Regardless of the time when the roentgen exposures began after mating, all irradiated females bore normal young except two. It was noticed, however, that the interval between the birth of the young and mating was lengthened in all cases with the exception of two. The observations are in accord with the results of Burckhard,[6] Bagg,[2] Parkes,[11] and others. No visible changes were noted in the parents. The period of delay varied from three to forty-one days, although in the majority of cases the delay was three to ten days. Three pairs of mice for which the irradiation began eight days after mating bore young forty-one days later. The failure of two pairs of mice to produce litters cannot be entirely attributed to the treatment. One of the females and one male of the two pairs studied, died shortly after the exposures. The average number per litter of the animals irradiated was 4.8 which was smaller than the average number per litter of the controls. It appears that while this dose did not produce marked sterility such as we observed with more intense irradiation described below, slight temporary changes in the fecundity of the animals are evident. All the control pairs produced litters within twenty-two days after mating. In no case were any abnormalities found among the young. There was no indication of any injury to the parents. With this dose of roentgen rays there seems to be no difference in the effect on the progeny whether the irradiation began on the sixth day or the nineteenth day after mating.

STERILIZATION DOSES

In another series of experiments conducted concurrently with the above, we subjected 8 pairs of young mice, eight weeks old to a roentgen exposure of three hours. The dose was administered for a period of one-half hour until a three-hour exposure was made. The irradiation began on the fourth day after mating, on 4 pairs, and was followed successively thereafter, until the required time had been reached. In the 4 remaining pairs the treatment began on the fifth day after mating and continued at intervals of two to three days

so that the last exposure was made on the nineteenth day after mating.

All the females in the irradiated set failed to produce young. There was no evidence of pregnancy in these does. The pairs remained undisturbed together for over two months. The animals did not appear to be affected. There was no evidence of epilation or burns at first, but approximately two months later, the females lost considerable quantities of hair. Differential blood counts invariably revealed marked leucopenia in both sexes. The question of the effect of roentgen rays on the differential blood count has been intensively studied in a large number of these animals. The results we shall leave to another time when a better opportunity is afforded us to make many more studies. It may be said, however, that under uniform treatment, the blood counts in these animals is quite variable.

To settle the question as to which sex of the animals is most affected by our treatment we separated the irradiated pairs, and mated the males with non-irradiated females that were known to be fertile and the irradiated females were mated with known fertile males.

After the second mating, the fertility of the males was established. Normal mice were born when these irradiated males and normal fertile females were mated. The birth of the young, however, did not occur until from forty-one to fifty-seven days after mating. The period of gestation was normal. This implies, it seems to us, a rather uniform action of the rays on these males. The number per litter varied from 3 to 10, the most frequent number in the litter was -. The irradiated females in all cases remained sterile up to from five to six months after the second mating. One of the irradiated females died four months after mating with a normal male. Undoubtedly, the testes of the male under the conditions of this experiment, appear to be less affected. It is quite probable that the testes are better protected by virtue of their position than are the ovaries.

PROGENY OF ROENTGEN IRRADIATED MALES AND FEMALES

A large number of the young of the one and a half hour roentgen irradiated males and females were allowed to develop. Three to four females and one male were put together in a large box at the time the animals reached sexual maturity. The selection of animals to be mated was made at random. Sisters and brothers were mated in one case, while in another case males and females of different parentage were used. In all, 29 females and 9 males from irradiated parents were mated. These gave birth to 168 young, of which 143 survived. Under these methods of mating we economized in space at the expense of the number of surviving young. In some boxes we found the mother failed to share in the burden of nursing the young. In some cases a number of the young of all the females were eaten by one mother. The young were examined for eye, foot, and other external defects. The dead were carefully dissected. In no case was any abnormality such as reported by Bagg and Little (1922-3) observed.

The mating of the F_3 and subsequent generations was carried out in a similar way, but at about the time of parturition the pregnant females were put into smaller boxes carefully labeled. The F_3, F_4, F_5, and F_6 generations yielded 169, 120, 141, 158 respectively. Over 150 of these animals were used for mouse tumor work. Complete autopsy of these animals together with the examination of over 300 young sacrificed and dead showed no abnormalities.

The progeny of the males which were irradiated for three hours were also studied. Here as in the one and a half hour irradiated animals from 3 to 4 females from different parents were mated with one male. In the F_1 generation 145 animals were borne by 24 females. All the young were carefully examined. Nothing abnormal was found that could be attributed to any genetical changes induced by the irradiation of the males.

In the F_2 generation, 129 young were observed. In these litters several runts appeared. Here no abnormalities were found. In the F_3 generation, 124 animals were studied. The dead were carefully examined. A relatively small number of those that reached sexual maturity were mated again, and in the F_4, F_5, and F_6, 56, 55 and [111 animals were born.

These were examined at birth and during their development without showing evidence of any morphological defects.

While these animals showed no physical defects, it was thought that they lacked vitality. This we at first regarded as a possible result of the irradiation. On isolation of the pregnant females, a larger percentage of the young animals reached maturity. The high mortality we attributed to lack of feeding.

While the number of mice reported here were kept under careful observation, a larger number were indirectly involved in the experiment, since studies were made on these mice which required dissection, and study of the visceral organs. In no single mouse coming from roentgen irradiated parentage or from our control animals, have we observed visceral abnormalities or malformation of the eye, foot and leg. Over 2500 animals were kept under observation during the period of our study and approximately 1000 mice were autopsied for the purposes of this work and another investigation conducted by the author in collaboration with Dr. S. Atkins of our laboratory.

SUMMARY

1. Our study shows that mice exposed to a dose of roentgen rays which corresponds to a small human erythema dose produces no visible effect upon the parents.

2. The period between mating and the birth of young is lengthened from three to forty-one days.

3. The young of these roentgen irradiated parent mice show no defects through the sixth generation.

4. By increasing the dose to what may be described as a large human erythema dose, sterility occurs. The female, when observations were discontinued in these studies, remained sterile five to six months after the irradiation. The males remained sterile for two and a half to three months.

5. The progeny of the irradiated male mated with a normal female bred through the sixth generation showed no apparent morphological defects.

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OS VESALIANUM PEDIS

BY GEORGE G. DAVIS, M.D.

CHICAGO, ILLINOIS

THE bone of Vesalius or vesalianum pedis corresponding to the bone of the same name in the hand, is the proximal and external part of the tuberosity of the fifth metatarsal. It is excessively rare. Dwight[1] who has made a very thorough study of the bones of the hand and foot, states that he has never seen it in the macerated foot of an adult and he has seen it but once in a roentgenogram and that was in a girl of twelve. Spronck[2] has seen it at birth, and Dwight thinks that probably he has made the same observation but he prefers to speak of his observation as doubtful inasmuch as he made slight use of the scalpel in dissecting bones that have been separated by Thiol's method or by a modification of it and he had a feeling that he might have made a cut, although he was not aware of having done so. Gruber[3] has seen a proximal epiphysis of the fifth metatarsal in an adult. However, this should not be confounded with the vesalianum. As this vesalianum is of interest from an anatomical point of view on account of its rarity and is of great importance from its medicolegal aspect in the differential diagnosis from fracture of the base of the fifth metatarsal, a short review of the writer's case follows:

CASE REPORT

H. B., aged fourteen, U. P. C. Co., mail department. On August 6, 1926, he was pushing a hand cart on the street when the front wheel of a Ford touring car, passing in front of him ran over his left foot, passing across at the level of the articulation of the metatarsophalangeal joint. The wheel, in passing over the foot, crossed from the median to the lateral aspect of the foot.

On or about August 21 it was said that an attorney for the boy had filed suit against the owner of the automobile for $10,000 damages to the boy's foot and the patient was referred to our offices for examination. He complained of pain in the region of the metatarsophalangeal joint of the left big toe (but did not complain of pain in the region of the base of the fifth metatarsal). At this time the physical findings of the injured foot were negative. However, it was deemed advisable under the circumstances to have a roentgenogram made and the patient was accordingly referred to a roentgenologist of national reputation who was requested to examine the left foot. The film (Fig. 1) was returned with the report which read as follows:

FIG. 1. Vesalianum pedis, incorrectly diagnosed as "fracture at the base of the fifth metatarsal bone."

"X-ray Examination of Instep of Left Foot. AP and Lateral Projections. There is fracture at the base of the fifth metatarsal bone. The fracture consists of a spicule of bone approximately one and a half cm. in length torn from the outer portion of this bone. All the remaining bones and joints included in this exposure appear to be normal."

Having read the report, and noted the roent-

genogram, my associate, Dr. H. W. Sutcliffe, reexamined the patient for tenderness in the region of the base of the fifth metatarsal and finding none, suspected that this might be a vesalianum instead of a fracture. Accordingly the patient was returned to the roentgenologist, the above points mentioned, and it was requested that both feet be examined this time.

The second film was of both feet (Fig. 2, and report was returned as follows: X-ray examination of foot, patient supine and lateral: There are no fractures of any of the bones of the ankles, feet, or toes. The several epiphyseal lines are normal to an individual of the age of this patient. Extra centers of ossification are seen at the bases of both fifth metatarsal bones. These have been named the "vesalianum."

FIG. 2. Vesalianum pedis, bilateral (same patient as Fig. 1), which verifies the incorrectness of previous diagnosis of "fracture of the base of the fifth metatarsal."

The fifth metatarsal is ossified usually from two centers: one for the body and one for the head. Ossification commences in the center of the body about the ninth week, and extends toward either extremity. The center for the head of the fifth metatarsal commences between the fifth and eighth year; it joins the body between the eighteenth and twentieth year.

On account of the absence of any sign of fracture in the writer's case and inasmuch as the condition is bilateral and symmetrical, a mistake with a fractured fragment is out of the question. This case shows, as does Gruber's case, that the process of the lateral protuberance of the fifth metatarsal may, on rare occasions occur as an epiphysis by developing from a special center of ossification, and that therefore the process of ossification of the fifth metatarsal bone is not always the same. It would be interesting to observe this patient after his twentieth year.

Evidently the differential diagnosis between vesalianum and fracture of the base of the fifth metatarsal is worthy of consideration. Therefore, two films of

cases of fracture of the base of the fifth metatarsal (Figs. 3 and 4) are introduced for comparison.

In making a diagnosis of vesalianum the following points should be remembered. First, that the condition occurs during the period before complete union of the epiphyses has taken place. In no case has this been noted in an adult. Second, the condition is bilateral. Third, there are not present the usual signs of a fracture, such as tenderness, discoloration and swelling. And fourth, the line of cleavage between the vesalianum and the base of the fifth metatarsal is longitudinal or parallel to the long axis of the fifth metatarsal and the adjacent surfaces of the two bodies are not sharp but rather smooth in outline.

In fracture of the base of the fifth metatarsal, the patient as a rule is an adult. In the cases of the patients in Figures 3 and 4 the ages were thirty and forty-nine respectively. In fractures the condition is usually unilateral though of course it might be bilateral, but the two sides would not be symmetrical as is the case in vesalianum. The usual signs of fracture would be present: tenderness, discoloration, swelling, etc. The line of fracture of the base of the fifth metatarsal is usually irregularly transverse to the longitudinal axis of the shaft of the bone.

Fig. 3. Fracture of base of fifth metatarsal.

Fig. 4. Fracture of base of fifth metatarsal.

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HEMORRHAGIC INFARCT OF THE LUNG

BY P. R. CASELLAS, M.D.

EL PASO, TEXAS

THE body of Mr. X. was brought for post mortem before the El Paso Clinical and Pathological Club. He was a charity patient, who had been seen by a member of the club a few minutes before death. Because of extreme emaciation, hematemesis, cough and fever, a tentative clinical diagnosis of pulmonary tuberculosis was made. The patient being semi-conscious, no clinical history was obtained. At autopsy, in both lungs, islands of consolidation, typical of a bronchopneumonic process, were found. The middle lobe was almost entirely consolidated. The center of this consolidation was dark purple in color and extremely soft. Overlying it was marked thickened visceral pleura which at places was adherent to the costal cartilage. With the exception of a slight hepatic congestion no pathology was found in other organs.

This case is reported with a view to further clarification of the well-established fact that not all pleurisies in annular formation are of tuberculous origin, and also as a means of denying the theory that all annular shadows represent pulmonary excavation.

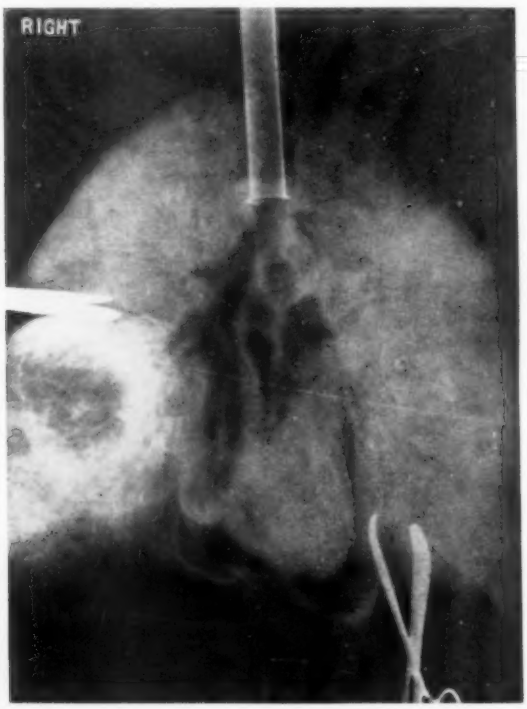

FIG. 1. Roentgenogram showing hemorrhagic infarct, middle lobe, surrounded by well-established pleurisy in annular formation. Throughout both lungs islands of consolidations due to a bronchopneumonic process are in evidence.

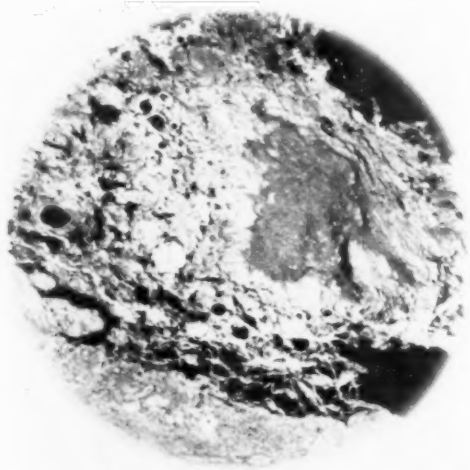

FIG. 2. Photomicrograph of section taken from the infarcted area shown in Figure 1.

Amberson,[1] Rusk and Randolph,[2] deJong and Pestel,[3] Piguet and Giraud[4] and the writer[5] have by autopsy study shown that dense roentgen shadows in annular formation more often represent pathological processes of a nature other than pulmonary tuberculous excavation, and that pleurisies in annular formation may accompany a nontuberculous pathological process in the lungs. It is our firm belief, derived from autopsy findings, that any pathological process of a subacute or chronic nature may give rise to pleuritic reactions similar to this case if the lesion is situated near enough to the periphery of the parenchyma so as to act as an irritant to the cellular element of the pleura.

The help of Dr. W. W. Waite, curator

of the El Paso Clinical and Pathological Club in making the photomicrograph and in many other ways, is acknowledged with appreciation.

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EDITORIALS

THE PRESENT STATUS OF THE ROENTGEN RAY IN THE DIAGNOSIS OF PULMONARY TUBERCULOSIS

FOR the diagnosis of pulmonary tuberculosis roentgenology has provided the most valuable additional method made available since Koch discovered the tubercle bacillus. As is so true of most innovations it took time to set the limitations of the method, and in the early days its worth was so impaired by fanciful interpretations of plates that it came to be rated very low. Clinicians who relied to any great degree on roentgen diagnosis of lung lesions labelled many cases erroneously, and a proportion of patients were received and treated in sanatoriums under the same delusions. More skeptical physicians hesitated to accept reports contradictory to clinical findings, Osler, for instance, in the 1914 edition of his textbook being moved to remark as follows: "More than any others, radiographers need the salutary lessons of the dead house to correct their visionary interpretations of shadows, particularly of those radiating from the roots of the lungs."

In spite of its remarkable fertility in great deeds it must be acknowledged that in the ardor of its youth roentgenology begot some monstrosities. Not the least among these was one that Osler probably meant but did not mention, namely, "peribronchial tuberculosis." Confronted with an arborization from the hilum of the lung that often showed a tremendous amount of more or less dense stippling or beading, the observer could easily conclude that tubercles only would be likely to cast such shadows, especially since some of the densities undoubtedly represented calcifications. Tubercles so numerous, it was reasoned, could only mean tuberculosis, and it was dubbed "peribronchial tuberculosis" to distinguish it from the "parenchymal" type. Even such niceties as the "prolongation" of linear markings to the periphery of the lung field were given weight in determining the presence of clinical disease. In the medical report of the Trudeau Sanatorium[1] for 1918 the following definition of "peribronchial tuberculosis" as classified by the roentgen ray is given: "The evidence of structural changes follows definitely the bronchial and arterial ramifications. The shadows are linear in character. The change in structure is evidenced by accentuation of the linear markings, with or without beading or studding, and with or without haziness or clouding."

For a season the propriety of diagnosing this as a type of clinical disease was not questioned. Physicians, who, with notable exceptions, approach the cradle of a new born science with fitting humility, were hard pressed to acknowledge the superiority of the roentgenological method and to forfeit confidence in the old maneuvers of physical examination which clearly failed to reveal this "peribronchial tuberculosis." Could they not—all of them—see with their own eyes the heavily studded, accentuated, prolonged, and "diseased peribronchial structures"—lesions that hitherto had remained wholly occult? Many patients, apprised of their plight after a roentgenographic examination made their way to tuberculosis sanatoriums. Of 255 cases reviewed in the 1918 report of the Trudeau Sanatorium no less than 34 (13.3 per cent) were definitely classified by roentgen ray as "peribronchial tuberculosis," although tubercle bacilli could be demonstrated in the sputum of only one of these patients during his stay in the sanatorium. The experience was duplicated elsewhere. But gradually it became evident that serial roentgenograms showed no further structural change in the pulmonary "lesions," and patients returning

[1] Thirty-fourth Annual Medical Report of the Trudeau Sanatorium, 1918, p. 8.

for reëxamination after some months or years of active life gave the same picture as they did originally. If ever they presented constitutional symptoms these were usually mild and vague, and not infrequently they disappeared after the extraction of abscessed teeth, the drainage of infected paranasal sinuses, or the treatment of some other condition such as previously unrecognized hyperthyroidism. Most striking of all is the observation that the anticipated mortality among patients with "peribronchial tuberculosis" has failed to materialize. Careful studies such as those of King[1] at Loomis and Heise[2] at Trudeau show that among all tuberculous patients treated in sanatoriums the expectancy of life after five to twenty years is much less than among the general population, and that among those dying the cause of death is tuberculosis in 80 to 100 per cent of the cases. Contrasted with these well-established facts are the findings of Heise and Sampson[3] that among 57 cases classified by the roentgenogram as "peribronchial (peritruncal) tuberculosis" only 2 deaths were known to occur (84 per cent of the cases were traced) in four or more years after completion of treatment, and neither of these was due to tuberculosis. Such evidence argues strongly against the justice of crediting the usually accepted criteria of "peribronchial tuberculosis," and raises doubt as to the correctness of even recognizing it as a pathological condition of clinical importance. We must at least examine other evidence that may influence the final verdict.

That a peribronchial distribution of tubercles may occasionally be demonstrated in specimens of the human lung is recorded by such pathologists as Hektoen[4] who describes the picture, however, only in association with and as a secondary extension from a bronchial or alveolar focus, assuming the bacillus to be implanted following its inhalation. He refers to the lesion as a peribronchial tuberculous lymphangitis. Krause[1] clearly shows experimentally that tubercles so situated may be the result of hematogenous infection of the lung, but in human beings these most likely would appear in the roentgenogram as a partial or complete miliary tuberculosis of the lung. That tubercle bacilli frequently traverse the pulmonary lymphatics on their way to the hilum lymph nodes without setting up a lasting lesion in the channels of passage (that is, a peribronchial tuberculous lymphangitis) is supported by a great volume of observations on the lungs of human beings, especially children, and of experimental animals. Lesions resulting from such passage are centered chiefly in the tracheobronchial lymph nodes. But tracheobronchial lymph node tuberculosis cannot be considered "peribronchial tuberculosis" in the usually accepted sense, a distinction not clearly drawn by Honeij[2] when he adduces the evidence in favor of the latter type of disease. In fact pathologists are extremely reticent in dignifying "peribronchial tuberculosis" as a separate type, and Aschoff[3] who believes that pulmonary tuberculosis almost always starts in the alveoli (acinus) pleads to have the terms tuberculous "bronchitis" and "peribronchitis" discarded because of the false conception they give of the pathogenesis of the disease.

On the clinical side there is practically nothing to speak for the existence of "peribronchial tuberculosis" in the usual roentgen meaning, but much against it. Heise's finding that none of these patients died of tuberculosis in four years or longer is most significant. Other evidence from the Trudeau Sanatorium adds to the significance. As mentioned above 13.3 per cent of the cases reported on in 1918 were definitely classified by the roentgen ray as "peribronchial tuberculosis." In 1925 the percentage had dropped to three. In the Trudeau reports[4] for 1923, 1924 and 1925 a total of 640 cases originally diagnosed

[1] King, H. M. Contribution to the study of prognosis in tuberculosis. *Johns Hopkins Hosp. Bull.*, 1916, xxvii, 322–327.

[2] Heise, F. H. The condition of patients twenty years after discharge from the Trudeau Sanatorium. *Am. Rev. Tuberc.*, 1919–20, iii, 497.

[3] Heise, F. H., and Sampson, H. L. An attempt to classify by means of the x-ray cases of suspected and definite pulmonary tuberculosis showing less than a definite parenchymatous x-ray lesion. *Am. Rev. Tuberc.*, 1924, ix, 406–408.

[4] Hektoen, L. Tubercle and Morbid Anatomy in Klebs' Tuberculosis. D. Appleton and Company, New York and London, 1909, p. 71.

[1] Krause, A. K. Studies on tuberculous infection. The localization of tuberculous infection in the rabbit with particular reference to that in the lungs. *Am. Rev. Tuberc.*, 1926, xiv, 243–270.

[2] Honeij, J. A. Peribronchial tuberculosis of the lungs with special reference to importance of the hilum. *Am. Rev. Tuberc.*, 1924, ix, 1–31.

[3] Aschoff, L. Ueber die naturlich Heilungsvorgange bei der Lungenphthise. J. F. Bergmann, München and Wiesbaden, 1922, p. 6.

[4] Thirty-ninth, Fortieth and Forty-first Annual Medical Reports of the Trudeau Sanatorium, 1923, 1924 and 1925.

as pulmonary tuberculosis and discharged after treatment in the sanatorium are analyzed. Of these a total of 29 were classified by the roentgen ray as "peritruncal" (peribronchial). After a period of residence in the sanatorium 17 of the 29 were discharged as nontuberculous, 9 as "suspected tuberculous," and only 3 were diagnosed clinically tuberculous; in only one case were tubercle bacilli demonstrated in the sputum while the patient was in the sanatorium although 5 more were said to have positive sputums before admission. In these recent Trudeau reports the term "peribronchial" is discarded in favor of "peritruncal" although the definition remains the same as quoted above, and a place in the roentgen-ray classification is still reserved for it. It is doubtful if the rose by any other name can smell any sweeter in the nostrils of those who, noting its withering, are prepared to cast it away. In fact, from Trudeau again comes evidence seeming to justify this last drastic gesture. Brown and Heise[1] have materially clarified the matter of diagnosis of pulmonary tuberculosis by thoroughly testing five criteria adopted some years ago. These are (1) the history of hemoptysis of a teaspoonful or more; (2) the occurrence of pleurisy with effusion; (3) the presence of persistent moderately coarse râles in the upper half of the chest; (4) a definite parenchymatous roentgen-ray lesion of a tuberculous character in the upper half of the chest; (5) tubercle bacilli in the sputum. They conclude that "when all of the five suggested diagnostic criteria are absent a negative diagnosis of clinical pulmonary tuberculosis can be safely made." This, of course, means that the roentgenographic interpretation of "peribronchial tuberculosis" is not of clinical worth. Likewise, Fales,[2] in a recent study of 411 cases at the U. S. Veterans' Hospital, No. 50, concludes among other things that "peribronchial infiltration, as seen by the roentgen ray, is of no importance in diagnosing pulmonary tuberculosis, as it was not found in any case in combination with positive sputum."

[1] Brown, L., and Heise, F. H. The value of the Trudeau Sanatorium's five diagnostic criteria of pulmonary tuberculosis in negative diagnoses. *Am. Rev. Tuberc.*, 1924, ix, 398–405.

[2] Fales, L. H. The relative value of the roentgen ray and physical signs in the diagnosis and treatment of pulmonary tuberculosis. *Am. J. M. Sc.*, 1926, clxxii, 382–393.

More than four years ago a committee of the National Tuberculosis Association,[1] the roentgen-ray division of which is composed of Pancoast, Baetjer and Dunham, in reporting on its efforts to establish standards for chest roentgenograms of normal children recommended against using the term "peribronchial tuberculosis" (as well as the term "parenchymatous tuberculosis") in the interpretation of such roentgenograms. From the citations given above it seems that the position of the committee is reasonable and that a diagnosis of "peribronchial tuberculosis" should not be reported. This need not imply that some term such as "peritruncal thickening" or "studding" should not be employed in a descriptive sense to convey to the mind the idea of structural change, represented by accentuated and prolonged linear markings with or without beading. At the same time it need not obscure the fact that some of the beading may represent isolated and healed tubercles, knowing, as we do, that most healthy adults display some such marks of tuberculous infection. Other beading is undoubtedly but the counterpart of nonspecific fibrosis, lymphoid hyperplasia, dust deposit or cross section of blood vessels.

The experience of the past decade has likewise yielded reasonably clear ideas as to the bearing of certain pleural shadows on the diagnosis of pulmonary tuberculosis. Until the significance of "apical caps," interlobar thickening and diaphragmatic adhesions could be proved clinically they naturally had to be regarded with much concern; consequently their meaning was sometimes overdrawn. Van Zwaluwenburg and Grabfield,[2] from their roentgenographic studies published in 1921, concluded that a tuberculous apical pleuritis occurs frequently, that chronologically the apical pleuritis precedes the pulmonary lesion, and that the infection probably reaches the pleura through the cervical lymphatics to which tubercle bacilli gain access via the tonsils. These conceptions are contrary to many established observations in the pathogenesis of pulmonary

[1] Clinical and x-ray findings in the chests of normal children. *Am. Rev. Tuberc.*, 1922, vi, 331.

[2] van Zwaluwenburg, J. G., and Grabfield, G. P. The tonsillar route of infection in pulmonary tuberculosis. *Am. Rev. Tuberc.*, 1921–22, v, 57; Apical pleuritis and its relationship to pulmonary tuberculosis. Ibid., 323.

tuberculosis. If infection is acquired by inhalation the first disease focus appears subpleurally in the primary lobule or acinus of the lung, a fact apparently proven beyond doubt by many investigators (cf. such papers as those of Aschoff[1] and Gardner[2]). If the bacillus gains access by ingestion and penetrates the mucous membrane of the alimentary canal at such portals of entry as the tonsils or the intestine, its further transit is via lymphatics and venous circulation before it can reach the lungs, there to settle out and set up a lesion. This mechanism of infection has been best elucidated by Krause in his series of "Studies on Tuberculous Infection." Here again pulmonary or tracheobronchial lymph node lesion is the first to appear, and extension to the pleura is secondary. (Other portals of entry play such a small part that they need not be considered here.) There is very little evidence to support the assumption of Van Zwaluwenburg and Grabfield that the bacillus can pass directly through the cervical lymphatics to the apical pleura; but there is much against it such as the observations on anatomical grounds by Jessipoff,[3] on bacteriological grounds by Cobbett,[4] and on pathological grounds by Beitzke.[5] Assuming that the shadows described by Van Zwaluwenburg and Grabfield always signify an apical pleuritis (which has not been proved pathologically) present knowledge is that this is probably most often tuberculous although not necessarily so; that, in the absence of underlying pulmonary infiltration or in the presence of such infiltration which appears as healed isolated tubercles or as cusps of fibrous tissue dipping inward from the pleura, the pleuritis can usually be considered clinically healed; that such pleuritis usually results as an extension from a pulmonary focus which may have healed completely leaving the pleuritic scar as its only remnant; that accentuated linear markings leading from the hilum to the apical "cap" probably are due to fibrosis and, therefore, in the absence of other pulmonary change, add nothing to the significance of the pleuritis; that tuberculous apical pleuritis is not to be regarded as the forerunner of apical pulmonary tuberculosis. The same probabilities and facts apply to pleuritic scars located in other isolated regions such as the interlobar fissures and the costophrenic sulci, and even to the widespread fibrous adhesive pleuritis that is so often the permanent residue of a tuberculous pleurisy with effusion. Such pleuritides, especially if there is reason to think they are of recent origin, may sometimes bear a period of observation until assurance can be had that they are healed; but in themselves they do not warrant a diagnosis of actual and, seldom, of impending pulmonary tuberculosis.

This statement appears contrary to some of the older writings such as those of Allard and Köster[1] who found in a large series of cases that patients with an "idiopathic" pleurisy (usually with effusion) in about 50 per cent of the instances developed definite pulmonary tuberculosis within five years. These authors, however, apparently did not ascertain how many patients of the group had actual pulmonary disease at the time of the pleurisy, a point of great importance in view of the weight of opinion that tuberculous pleurisy is never primary but practically always represents an extension from an intrapulmonary focus. Cabot,[2] on the other hand, followed cases of *uncomplicated* serous pleurisy (that is, without intrapulmonary disease demonstrable by physical examination) and found 80 per cent in good health after five years or more. His work was reported before the days of roentgen-ray diagnosis, and it is fair to assume that, if this aid had been available, some of the cases would have shown pulmonary lesions coincidental with or preceding the pleurisy. While the evidence from such studies presaged the view (now accepted as proved beyond doubt) that the bulk of "idiopathic" pleurisies are tuberculous, it by no means con-

[1] Aschoff, L. Lectures on Pathology. Paul B. Hoeber, Inc., 1924, p. 34.

[2] Gardner, L. U. Healing by resolution in experimental pulmonary tuberculosis. *Am. Rev. Tuberc.*, 1922, vi, 163–182.

[3] Jessipoff, K. D. Die anatomischen Verbindungen der Lymphbahnen des Hals- und Brustgebietes, in denen die Tuberkuloseinfektion zirkulieren kann und die Untersuchungsmethodik. *Tuberkulos*, 1923, iii, 42.

[4] Cobbett, L. The rôle of the three types of tubercle bacilli in human and animal tuberculosis. *J. State Med.*, 1922, xxx, 160–176.

[5] Beitzke, H. Uber die Reinfektion bei der Tuberkulose. *Beitr. z. klin. d. Tuberk.*, 1923, lvi, 304–313.

[1] Allard, H., and Köster, H. Tuberkulos efter pleurit. *Hygiea*, 1911, lxxiii, 1105–1139.

[2] Cabot, R. C. Prognosis of pleurisy with serous effusion. *Tr. Ass. Am. Phys.*, 1902, xvii, 156.

tradicts the modern idea that pleurisy is secondary to the pulmonary lesion, nor does it nullify the conception that isolated patches of tuberculous pleuritic thickening, apical or elsewhere, have no immediate clinical meaning in the absence of clinical disease within the lung.

Misinterpretation of hilum shadows, along with misinterpretation of linear markings, has probably been responsible for more false diagnoses in chest roentgenology than any other factor. At first these densities were regarded as the counterpart of the bronchial tree and hence helped to foster incorrect ideas of "peribronchial tuberculosis." The visionariness of most of these ideas became apparent when such investigations as those of Delherm and Chaperon,[1] Garcin,[2] and Marquis[3] revealed that the "hilum" and its subdivisions of trunks and linear markings represent chiefly the branches of the pulmonary arteries, that normal lymph nodes in the hilum region cast slight or no shadows, and that bronchial walls are usually not visible in the well-aerated lung field. Then, refinements of technique, such as the method of McPhedran and Weyl[4] which makes possible the exposure of the roentgenographic film in a selected phase of the cardiac cycle, proved that certain peculiarities of the hilum shadow are due to movement imparted from the heart and large vessels, and that some nodular densities in the hilum region or along the linear markings may be ascribed to blood vessels pictured in cross section. Such evidence counsels extreme caution in drawing broad inferences from the roentgenographic finding of "slight hilum changes." When gross nodular enlargements appear in this region (assuming that the appearance is not due to faulty technique) suggesting caseous adenitis, the impression sometimes may be strengthened by lateral or oblique views of the thorax to show the tracheobronchial adenitis that usually is part and parcel of the disease. Even then one cannot always identify conclusively the etiology of the adenitis from the roentgen ray alone. For instance, Bernard and Vitry[1] found among 194 children with unquestionable enlargement of the tracheobronchial glands that 64 had repeatedly negative tuberculin tests. Accuracy in ascribing such enlargements to tuberculous infection can be attained, according to the recent work of Opie and McPhedran,[2] only by extremely careful technique in roentgenographic examination and by adhering to such strict criteria of interpretation as they mention. The conservative point of view in regard to the diagnosis of tuberculosis in this vexatious tracheobronchial region is stated in the sixth edition (1926) of "Diagnostic Standards," a booklet published by the National Tuberculosis Association, as follows: "Interpretation of the films should be made by an experienced physician, who is familiar not only with chest films in general, but with films of children's lungs in particular. He should also have a clinical background, and the interpretation should not be independent of a careful consideration of the history, symptoms and physical examination. This should be inclusive of the whole respiratory tract. The bronchial group of lymph nodes may be enlarged from so many sources that the diagnosis must be made by elimination. Therefore, an X-ray interpretation made by reading a film without other considerations is of little value in these cases."

It may be noted in passing that roentgenographic methods are proving of increasing value in revealing the pathogenesis of tuberculosis within the lung. For example, it has long been held by many students of the disease that a frequent type of extension is by retrograde lymphatic propagation from the hilum outward. Gräff and Küpferle,[3] however, have shown at least in adults that such extension is uncommon and that the roentgenographic appearance of a "sunburst" of tuberculous infil-

[1] Delherm, L., and Chaperon, R. Comment doit on interpreter des ombres hilaires normales? *J. de radiol. et d'électrol.*, 1923, vii, 329–334; 497–500.

[2] Garcin, J. Anatomie radiologique des poumons. Les arborisations pulmonaires. *J. de radiol. et d'électrol.*, 1924, viii, 8–16; Les arborisations pulmonaires. *Bull. et mém. de la soc. de radiol. méd. de France*, 1923, xi, 201–204; Definition de l'état normal et de l'état pathologique des arborisations pulmonaires, *Ibid.*, 1924, xii, 115–126.

[3] Marquis, W. J. An experimental study of the markings seen in the roentgenograms of the lungs of normal dogs. Am. J. Roentgenol. & Rad. Therapy, 1925, xiv, 247–250.

[4] McPhedran, F. M., and Weyl, C. N. Automatic synchronization of roentgen-ray exposures. *Am. J. M. Sc.*, 1925, clxix, 510–516.

[1] Bernard, L., and Vitry. Les adénopathies trachéo-bronchiques de la seconde enfance. *Rev. internat. de méd., et de chir., Par.*, 1923, xxxiv, 109–114; *Bull. Acad. de méd., Par.*, 1923, xc, 41–53.

[2] Opie, E. L., and McPhedran, F. M. The contagion of tuberculosis. *Am. Rev. Tuberc.*, 1926, xiv, 347–419.

[3] Gräff, S., and Küpferle, L. Die Lungenphthisie. Julius Springer, Berlin, 1923.

tration radiating from the hilum practically always represents a bronchiogenic dissemination of the disease from some older focus such as an apical cavity or a ruptured caseous tracheobronchial lymph node.

It would seem not to be over-optimistic to take the view that today the roentgen diagnosis of pulmonary tuberculosis, while by no means infallible, has become a thing of relative accuracy. The roentgenologist should in his report describe all structural changes he can discern within the chest, such as peribronchial (or, better, peritruncal) beading, pleuritic adhesions or thickenings, and slight or moderate enlargement of tracheobronchial lymph nodes, but in this class of evidence alone experience has found scant justification for diagnosing clinical tuberculosis. Practically all adults harbor tuberculous infection, but only a small number, clinical tuberculosis. In the former case the tuberculous deposits are usually small, isolated and clinically healed and occur most frequently in the lungs or their draining lymph nodes. Where these changes are well marked and healing does not appear sufficiently advanced some have chosen to label the case "latent tuberculosis." The term, however, carries an implication of impending clinical disease that may not be justified. While Opie and McPhedran have found that "recognizable tracheobronchial tuberculosis in children has grave significance and may serve as an index of manifest disease" and think that "latent" apical tuberculosis in an adolescent child may in some cases be the precursor of manifest disease in early adult life, the fact remains, nevertheless, that most adults, while they may show discrete pulmonary tubercles roentgenologically, never develop clinical tuberculosis. The diagnosis of clinical disease, therefore, must be founded on something more definite than the roentgenographic changes mentioned.

The studies of recent years have evolved a working rule that appears sound. This is epitomized in the National Tuberculosis Association's "Diagnostic Standards" as follows: "Definite [roentgenographic] parenchymal changes are seen in nearly all instances of proved pulmonary tuberculosis. Absence of such changes demands other proof of the existence of the disease." It is specified that tuberculous lesions are located usually in the upper half of the chest. If, in the absence of these changes which proclaim themselves in the roentgen film as "mottling," "cirrhose clouding," or gross nodulation in the outer and upper part of the lung field, the roentgenologist refrains from making a diagnosis of clinical pulmonary tuberculosis, he will not often be in error. This view is well substantiated by the methodical and painstaking observations of Brown and Heise[1] and of Bissell.[2] Other evidence of a clinical sort may be strongly suggestive of tuberculosis but, unless such pulmonary infiltration is demonstrable by roentgen rays, or other proof is forthcoming, the clinician must look further afield. Thought must be given to nontuberculous disease and possibly to extrapulmonary tuberculosis, remembering that in rare cases even in adults tracheobronchial tuberculosis may ulcerate into the trachea or a bronchus and give rise to sputum containing tubercle bacilli.

Bissell stresses the points that the province of the roentgenologist is to discover the lesion and describe it as nearly as possible in terms of its pathological significance, but not to decide on the type of treatment indicated. While it is generally agreed that an estimate of the "activity" of a pulmonary tuberculous lesion is difficult from a single observation, much is to be said for what the Germans aptly call a "qualitative diagnosis," i.e., a description not only of the extent of the lesions but also of their character in fundamental pathological terms and of their state of healing if any is present. From the time of Laennec pathologists have distinguished two chief types of tuberculosis, the exudative (pneumonic, caseous) and the productive (proliferative, fibroid). Clinically these two types may be of widely different significance. Exudative tuberculosis may undergo remarkable healing by absorption or it may rapidly caseate and excavate; productive lesions are less likely to do either

[1] Brown, L., and Heise, F. H. The value of the Trudeau Sanatorium's five diagnostic criteria of pulmonary tuberculosis in negative diagnoses. *Am. Rev. Tuberc.* 1924, ix, 398–405.

[2] Bissell, F. S. An attempt to appraise the roentgenological method of diagnosis in pulmonary tuberculosis. AM. J. ROENTGENOL. & RAD. THERAPY, 1926, xvi, 544–548.

but tend often to heal slowly by fibrosis or to advance gradually. Usually the two types are associated in the same lung. A knowledge of the "qualitative diagnosis" is important in both prognosis and treatment. Gräff and Küpferle[1] in their atlas have shown the possibilities of roentgenographic methods in identifying these different processes, the difficulties being discussed by Curschmann.[2]

Likewise the recognition of the extent and character of cavities is of special value. It has long been known that some cavities are "silent;" that is, they are not revealed by physical examination. With the advent and perfection of the roentgen ray, however, few of these lesions should escape us because while sometimes "silent" they are rarely invisible. Preceding the easily recognized rarefaction, representing excavation, one usually sees in the roentgenogram a moth-eaten appearance amid heavy densities denoting caseation. This appearance was first discussed by Mantoux and Maingot[3] who recognized it as the early stage of cavity, the moth-eaten areas frequently merging later to form one or more larger cavities. The latter often stand out as solitary rings, or "annular shadows," the interpretation of which has been the subject of considerable discussion in the literature in recent years. Serial roentgenograms of cases in which these shadows occur sometimes show mutations assumed to rule out cavity as their anatomic basis. Sampson, Heise and Brown[4] were led to believe that they are sometimes located in the pleura, and in this location they considered the lesion to be a pocketed pneumothorax, a theory that has not been supported by good evidence. Amberson[5] sought to disprove this theory and offered the explanation of a localized pleurisy as the cause. Whatever the pleural lesion may be, the idea of a false cavity shadow was seized upon too avidly by roentgen-ray and tuberculosis workers, and many undoubtedly true cavity shadows were and still are interpreted as pneumothoraces or pleurisies. The work of Burnham and P. K. Brown,[1] Dunham and Norton,[2] and Bruns and Barnwell[3] proves that the majority of annular shadows appearing in roentgenograms of tuberculous lungs represent cavities, even though the center of the shadow may not appear rarefied and it may not be surrounded by much infiltration. The roentgenologist, therefore, should in such cases report the great probability of cavity unless there is very positive evidence to suggest a pleural lesion. In this connection attention may be called to the observation of Ameuille and Levesque[4] that the demonstration of a draining bronchus connected with a questionable annular shadow is presumptive proof that the latter denotes cavity.

Lipiodol, which has taken such a conspicuous place as a contrast medium for the diagnosis of nontuberculous lung disease, has been suggested for the differentiation of true and false cavity shadows in pulmonary tuberculosis. Pirie[5] also mentions its value in showing the extent of collapse of the tuberculous lung brought about by thoracoplasty. However, great caution seems indicated when bringing lipiodol into contact with tuberculous lesions that show little or no healing. Lichtwitz[6] observed an exacerbation of a lobular pneumonic tuberculosis following the introduction of 4 c.c. of lipiodol. Cottenot,[7] Fiessinger and Lemaire,[8] and Castex, Romano and Gonzalez[9] also report more or less similar accidents following

[1] Gräff, S., and Küpferle, L. Die Lungenphthisie. Julius Springer, Berlin, 1923.
[2] Curschmann, W. Zur Frage der qualitativen Diagnose und Einteilung der Lungentuberkulose. *Beitr. z. klin. d. Tuberk.*, 1925, lxi, 399.
[3] Mantoux, C., and Maingot, G. Les images cavitaires dans la tuberculose pulmonaire. *Presse méd.*, 1918, xxvi, 125.
[4] Sampson, H. L., Heise, F. H., and Brown, L. A study of pulmonary and pleural annular radiographic shadows. *Am. Rev. Tuberc.*, 1919, ii, 664.
[5] Amberson, J. B. Jr. The nature and differentiation of pleural annular shadows. Am. J. Roentgenol. & Rad. Therapy, 1924, xii, 438–443.

[1] Burnham, M. P., and Brown, P. K. A criticism of recent interpretations of annular shadows in lung roentgenograms. *Am. Rev. Tuberc.*, 1922, vi, 469–476.
[2] Dunham, H. K., and Norton, V. Observations of annular shadows and cavities at the Cincinnati Tuberculosis Sanatorium. *Am. Rev. Tuberc.*, 1924, x, 306–318.
[3] Bruns, E. H., and Barnwell, J. DuB. The interpretation of annular shadows appearing in radiograms of the lungs. *Am. Rev. Tuberc.*, 1926, xiv, 58–68.
[4] Ameuille, P., and Levesque. La bronche de drainage des cavernes tuberculeuses. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1923, xlvii, 612–614.
[5] Pirie, A. H. Diseases of the chest demonstrated by lipiodol. Am. J. Roentgenol. & Rad. Therapy, 1926, xvi, 553–558.
[6] Lichtwitz, O. Schädigung durch Lipiodol als Kontrastmittel bei Lungentuberkulose. *Wein. klin. Wchnschr.*, 1926, xxxix, 133–134.
[7] Cottenot. Au sujet des accidents consécutifs aux injections intra-trachéales de lipiodol. *Bull. et mém. de la soc. de radiol. méd. de France*, 1926, xiv, 16.
[8] Fiessinger, N., and Lemaire, A. Des injections lipiodolées comme procédé d'exploration et de traitement des sérites tuberculeuses. *Presse méd.*, 1926, xxxiv, 209–211.
[9] Castex, M. R., Romano, N., and Gonzalez, H. L'exploration radiologique du pyo-pneumo-kyste sous-phrénique par l'injection de lipiodol. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1926, l, 222–226.

injections either into the tuberculous lung or the tuberculous pleura. A further objection is that lipiodol retained in the lung confuses the roentgenographic shadows of tuberculous infiltration and gives rise at times to such false physical signs as increased moist râles and diminished breath sounds.

In this rehearsal there appears to be ample justification for the modern view that a chest examination cannot be deemed complete without a roentgen examination. The responsibilities of the roentgenologist, therefore, are great, and it behooves him to discard vagaries of diagnosis and to rely on definite evidence to support his interpretations. Not only must he make a diagnosis but he must also meet the increasing need for a "qualitative diagnosis." This presages better times because it will necessitate repeated correlation of pathological, roentgenographic and clinical data which is the great hope of future advances in the diagnosis and treatment of pulmonary tuberculosis. Evidence may be definite indeed, but, despite this, interpretation can be erroneous. If interpretation is backed by judgment born of collective and correlated experience the patient will profit proportionately.

J. Burns Amberson, Jr.

THE NORMAL CHEST AND TUBERCULOSIS

Proficiency in roentgen diagnosis, especially in the chest, must be developed from familiarity with normal roentgenographic appearances, a knowledge of pathology and experience in interpreting disease from alterations in shadows induced by pathological processes. Our knowledge of normal roentgenographic appearances is usually based upon a long experience in examining cases which are diagnosed by roentgen-ray study as negative. It is not often that the busy roentgenologist has the opportunity or the time, aside from the expense entailed, to study a large series of healthy individuals passed upon by a clinician as free from disease. It is uncommon, also, for a group of roentgenologists to pursue such a study in a way that permits of an interchange of ideas and opinions with a view to arriving at accurate conclusions for the mutual benefit of all of us. The result of such a piece of work appears in this issue of The Journal in the report of the Normal Chest Committee appointed by the Committee on Medical Research of the National Tuberculosis Association, and printed through the courtesy of the American Review of Tuberculosis.

The increasing importance of accurate roentgen diagnosis in pulmonary tuberculosis has been realized for some time by those especially engaged in the study of this disease. Unfortunately, there has been a certain lack of uniformity of opinion as to the exact appearances which should be regarded as indicative of the various lesions, and a rather varying nomenclature descriptive of the roentgen signs of the disease, aside from the usual variations in technique and experience in interpretation common to all laboratory work of this nature. These circumstances have acted as deterring factors in the application of this diagnostic method to its fullest extent. The Committee on Medical Research of the National Tuberculosis Association realized that the best way to clear up the uncertainty and doubt would be to appoint a committee of internists and roentgenologists to first study the normal or healthy chest and define the roentgen-ray appearances in understandable terms, and then to describe all departures from the normal that could be interpreted as evidences of tuberculous infection. Having completed its work on the healthy child and adult chests, the same committee, augmented by the addition of several men whose reputations are well known in the fields of pathology, roentgenology and tuberculosis, has been requested to continue its work in an attempt to define the roentgen-ray appearances characteristic of tuberculous infection and the nomenclature best suited for descriptive purposes.

The normal chest report is not the opinion of a single individual, but represents a common agreement among several men of more or less widely different views at the start. The task was not an easy one. Consultations with pathologists, internists and others were freely sought and obtained, with much profit. There are several fea-

tures in the report to which special attention might be directed, but as it is published in full, any abstract is out of place here. The lateral view as a routine procedure has already brought good results, especially in clearing up obscure basal lesions and revealing loculated effusions in the posterior costophrenic angle and interlobar collections not shown in the fore-and-aft direction.

After thorough familiarity with the roentgenographic appearances of the normal chest it might be permissible to go a step further and describe the changes induced by early tuberculous infection. In so doing we are not in any way offering suggestions originating with the Normal Chest Committee. The following abstract is taken from recent articles by Dr. Dunham and from personal communications from him and is presented by his sanction:

The pulmonary exudates of tuberculous lesions (adult type) develop early. They are found immediately under the pleura, hence the possibility of early clinical and roentgen diagnosis. An exudate is the first reaction to the implantation of tubercle bacilli in tissues of a sensitized individual. This may be largely serous, but if the infection is severe there is a polymorphonuclear exudate followed soon by a mononuclear exudate, and subsequently by the proliferation of fixed tissue cells. From these cell elements the tubercle is formed later. The connective tissue septa separating the secondary lobules act as excellent barriers to the spread of infection by continuity of any lung infection characterized by an exudate. In tuberculosis, exudation starting within a secondary lobule is limited by the barrier or septum, and no spread will take place until cavitation occurs. Other secondary lobules may be infected at the same time or subsequently. The shadows of these secondary lobules, the seat of exudation, are the fans (or cones) of Dunham, but may be produced by any disease characterized by exudation, as pneumonia, influenza or infarct. Roentgen-ray densities caused by pathological changes vary in quality or density from that of serous exudate to cellular exudate, fibrosis, caseation to the extreme of calcification. Any case exhibiting multiple lesions will be characterized by these densities of different qualities, which gives the typical roentgen-ray picture of pulmonary tuberculosis. It is a disease of successive infections, due to spread or new infection, with lesions of different ages, and producing, therefore, shadows of different degrees of density by new invasion, repair or destruction.

The Dunham fan was originally named from its outline in the roentgenogram. It is a triangular density, sometimes open, often ribbed and sometimes closed. When first noted, no one understood its underlying pathology sufficiently well to justify the use of the concrete term "lobular pneumonia," but this is what it is, and is caused by the inflammatory exudate which generally follows tuberculous infection in the adult lung. The areas are really cone shaped until the inflammatory exudate is absorbed and contractile scar tissue has distorted the normal lung tissue into some other shape. The fan or cone is unusual in the child under twelve years, and when seen then, the prognosis is grave. Adult cases with lobular pneumonia fans usually recover, with care. Treatment must be continued until the areas are absorbed or walled off by scar tissue, hence the value of serial roentgenography in treatment. The pathological picture in more advanced adult cases is the result of conglomerate fans in varying degrees of repair and degeneration. Aspiration of infected material from an apical lesion may cause a tuberculous bronchopneumonia in a lower lobe.

Studding along the linear markings of the outer zone is generally due to small tubercles within an old fan from which the exudate has been absorbed. There are many cases of arrested tuberculosis which show only linear markings going to an apex. These are the thickened septa which have contracted after the exudate has been absorbed.

The above abstract is the idea of roentgen-ray appearances of pulmonary tuberculosis as worked out by one man of large experience in the study of the disease from all angles. Dr. Dunham has passed upon it as a concise expression of what he has been trying to teach from his experi-

ence. It is to be hoped that the subsequent work of the committee will clear the atmosphere of all doubt as to the exact roentgen-ray evidence of pulmonary tuberculosis.

HENRY K. PANCOAST.

A NEW JOURNAL OF RADIOLOGY

We have recently received the first issue, that of January, 1927, of the "*Boletin de la Sociedad Mexicana de Electro-Radiologia.*" As its name indicates, the new journal is the official organ of the newly organized Mexican Society of Electro-Radiology. The editor is Dr. Mariano Somonte of Mexico City.

We extend our felicitations to the new society and our congratulations to the editor and publishers of the new journal upon the appearance and contents of its first number.

Subscribers to THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY *visiting New York City, are invited to make the office of* THE JOURNAL *(76 Fifth Avenue, New York) their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this column solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. Charles L. Martin, Dallas, Texas.
Twenty-eighth annual meeting, Montreal, Can., Sept. 20–23, 1927.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. Fred M. Hodges, 801 West Grace St., Richmond, Va.
Annual meeting, Washington, D. C., May 16–20, 1927.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Dr. Robert J. May, St. Luke's Hospital, Cleveland, Ohio.
Annual meeting, New Orleans, La., Nov. 28–Dec. 2, 1927.

RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION
Secretary, Dr. E. C. Samuel, New Orleans, La.
Annual meeting, Memphis, Tenn., Nov. 14–17, 1927.

BUFFALO RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi. 610 Niagara St.
Meets second Monday of each month except during the summer months, the place of meeting to be selected by the host.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. R. A. Arens, Michael Reese Hospital
Meets monthly on second Thursday from October to May (except during month of December) at Virginia Hotel. Dinner at 6 P.M., scientific session at 8 P.M.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. James H. West, 8314 Euclid Ave.
Meetings are held at 6 o'clock at the University Club, on the fourth Monday evening of each month from September to April, inclusive.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. Henry L. Ulbrich, 1130 E. Grand Blvd.
Meets monthly on second Friday from October to May, at Wayne County Medical Society Building.

CENTRAL ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. H. C. Kariher, Decatur, Illinois.
Regular meetings held quarterly.

NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. M. C. Sosman, Peter Bent Brigham Hospital, Boston, Mass.
Meets monthly on third Friday, Boston Medical Library.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr. W. W. Belden, 8 West 16th St.
Meets monthly on second Monday, New York Academy of Medicine.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. D. S. Childs, 316 Gurney Bldg., Syracuse, N. Y. Three meetings a year—April, August and November.

PACIFIC COAST ROENTGEN RAY SOCIETY
Secretary, Dr. Harold B. Thompson, Seattle, Wash.
Two meetings a year.

ROENTGEN RAY SOCIETY OF CENTRAL PENNSYLVANIA
Secretary, Dr. W. E. Reiley, Clearfield, Penna.
Two meetings a year, April and October.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary, Dr. Eugene Pendergrass, University of Pennsylvania, Philadelphia.
Meets monthly on first Thursday evening, Pennsylvania Hospital.

ROCHESTER ROENTGEN RAY SOCIETY, ROCHESTER, N. Y.
Secretary, Dr. S. C. Davidson, Highland Hospital.
Meets monthly on the first Friday evening at 7.45 at the Rochester Medical Association Building.

ST. LOUIS ROENTGEN CLUB
Secretary-Treasurer, Dr. L. R. Sante, Metropolitan Building.
Meets first week of each month. Time and place of meetings designated by president.

TEXAS RADIOLOGICAL SOCIETY
Secretary, Dr. Davis Spangler, Dallas, Texas.
Meets annually.

British Empire

BRITISH RÖNTGEN SOCIETY
Meets on the first Tuesday of each month from November to June inclusive, at 8.15 P.M., at the British Institute of Radiology, 32 Welbeck St., London; W. 1.

BRITISH INSTITUTE OF RADIOLOGY
Secretary, Dr. John Muir, 32 Welbeck St., London, W. 1.
Meets at 32 Welbeck St., but regular dates and times of meeting have not yet been arranged.

ELECTRO-THERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)
Meets on the third Friday of each month during the winter at 8.30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

RADIOLOGICAL SECTION, AUSTRALASIAN MEDICAL CONGRESS
Secretary, Dr. C. A. Anderson, The Hospital, Dunedin.

RADIOLOGICAL SECTION OF THE VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION
Secretary, Dr. Colin Macdonald, Lister House, 61 Collins St., Melbourne, Australia.
Meets monthly at Melbourne during the winter.

CANADIAN RADIOLOGICAL SOCIETY
Secretary, Dr. E. C. Brooks, Montreal.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION
Secretary, Dr. P. C. Fenwick, The Hospital, Christchurch.
Meets annually.

* Secretaries of societies not here listed are requested to send the necessary information to the editor.

CONTINENTAL EUROPE

BELGIAN SOCIETY OF ROENTGENOLOGY
Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).
Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

ASSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHOSLOVAKIA
Secretary, Dr. Walter Altschul, German University, Prague, 11/52.

DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY
Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

SOCIETA ITALIANA RADIOLOGIA MEDICA
Secretary, Professor M. Ponzio, University of Turin, Turin.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD, USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs S. A. Reinberg and S. G. Simonson.
Meets annually.
Fifth Annual Meeting in Kiev, Ukraine, May, 1928.

LENINGRAD ROENTGEN RAY SOCIETY
Secretaries, Drs. S. G. Simonson and G. A. Gusterin.
Meets monthly on the first Monday at 8 o'clock in the State Institute of Roentgenology and Radiology, Leningrad.

MOSCOW ROENTGEN RAY SOCIETY
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.
Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society

SCANDINAVIAN ROENTGEN SOCIETIES
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with the exception of the Denmark Society, meets every second month except in the summertime:

SOCIETY OF MEDICAL RADIOLOGY OF SWEDEN
Meets in Stockholm.

SOCIETY OF MEDICAL RADIOLOGY IN NORWAY
Meets in Oslo.

SOCIETY OF MEDICAL RADIOLOGY IN DENMARK
Secretary, Dr. H. Scheuermann, Copenhagen
Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

SOTCIEY OF MEDICAL RADIOLOGY IN FINLAND
Meets in Helsingfors.

VIENNA SOCIETY OF ROENTGENOLOGY
Secretary, Professor Holzknecht, Vienna, IX, General Hospital.
Meets on the first Tuesday of each month from October to July.

FIFTH CONVENTION OF THE UNION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS OF THE CZECHOSLOVAKIAN REPUBLIC HELD AT PRAGUE, OCTOBER 23 AND 24, 1926

Dr. Jaksch-Wartenhorst was the presiding officer and Dr. Altschul the business manager. Among those present at the well-attended meetings were the rector of the German University of Prague, the dean of the German medical faculty, the president of the German Roentgen Society, Berlin, the president of the Vienna Roentgen Association, the president and secretary of the Czechoslovakian Roentgen Society and the secretary of the Reich Union of German Physicians. The following honorary members were elected: Holzknecht of Vienna and Jaksch-Wartenhorst of Prague. Eulogies were read for the deceased members Opitz of Freiburg by G. A. Wagner and for Friedl-Pick of Prague by Jaksch-Wartenhorst.

THERAPY (MILD IRRADIATION)

Main Discussion

In the foreground of interest stood the discussion by Holzknecht, Vienna, on "Mild Irradiation." He treated the theme in the sense that "mild irradiation" histologically was the opposite of maximal intensive irradiation and that the concept today has value only in the sense of emphasizing attention to the appropriate dose, that is, of a minimum sufficient for success in that group of diseases which includes perhaps all acute and chronic inflammations, a group in which beyond a certain dose an effect fails to appear or is diminished. Examples were cited. After satisfying this demand, the concept will disappear and roentgen therapy will find itself free from the prejudices of the conservative and the extirpative therapy to pursue its proper functions. Following this paper there was a lively discussion participated in by Kodon of Brünn, Haudek of Vienna, Altschul and Wagner of Prague.

The subject of mild irradiation was treated in a number of other papers. Hellebrand of Tetschen reported his experience with mild irradiation in a small roentgen institute. He obtained good results with very small doses which were smaller than those customarily employed. G. A. Wagner of Prague reported on mild irradiation in inflammatory diseases in gynecology. His material, part of which was published by C. Schoenhof, comprised more than 360 cases with 216 follow-up examinations. From the observations in this series of

cases it is made evident that this mode of treatment of inflammatory gynecological diseases may successfully compete with the other conservative methods of treatment, and in the case of single infected foci may compete with operative methods. The gynecological diseases, however, occupy a special position among the other inflammatory diseases for two reasons. First the gynecological irradiation always delivers a certain dose of rays to the germinal glands whether involved or not and which are specially sensitive to the rays. Secondly, the desired effect, according to Heidenhain, of a purulent softening in inflammatory diseases of the uterine adnexa is not an indifferent matter and may indeed become dangerous; because one is dealing here with intraperitoneal organs, and relief by an incision is not always easily possible because the purulent foci thus developed are often not readily reached, and moreover, the pus is by no means sterile as was found almost without exception in the Prague series, contrary to the findings of Heidenhain. Besides the good results there have also been failures and certain cases have been made worse as a result of irradiation; and indeed some deaths have resulted in irradiated women.

Heimann of Breslau discussed mild ovarian irradiations and pregnancy. Wagner and Schoenhof were unable to find any changes in normal irradiated ovaries that could be assigned to mild irradiation. Heimann had the opportunity to examine an ovary histologically, which had received a mild irradiation for the treatment of amenorrhea and in which case not only menstruation but also conception with normal birth had taken place. This author also could find no changes due to the mild irradiation.

Schiller and Altschul reported exceedingly good results with the roentgen treatment of duodenal and gastric ulcer. Small doses were found to be highly effective and the authors recommend the employment of these small doses. In the discussion Palugyay and Haudek confirmed the good results obtained with the roentgen treatment, while Gütig recommended surgical treatment.

Steiner mentioned the special indication in postoperative ulcus pepticus jejuni. Fischl recommended the novoprotein treatment. Herrnheiser and Redisch of Prague discussed the indication for therapy in hyperthyroidism. Biedl and Redisch have established a classification into genuine Basedow's disease and pure hyperthyroidism. While genuine Basedow's disease responds very satisfactorily to Lugol treatment, cases of pure hyperthyroidism which are unsuitable for iodine treatment are suitable subjects for roentgen therapy. The subject was discussed by Biedl, Guhr and Gütig.

Bardachzi of Aussig favors a slow, conservative procedure in the treatment of leucemias. In addition to irradiations of the spleen, the bones should receive irradiations in cases of the myeloid type, and the lymph glands should be irradiated in cases of the lymphatic type.

MISCELLANEOUS THERAPY

S. Schoenhof of Prague made further interesting observations on indirect roentgen irradiations in skin diseases. The best results were obtained in lichen ruber planus. Success in individual cases was obtained in scleroderma, vitiligo and Raynaud's disease. On the basis of theoretical considerations, he suggests the irradiation of the spinal cord for the treatment of torpid crural ulcers, kraurosis of the vulva and especially in roentgen ulcer.

Weil of Prague reported on the therapy of a transverse lesion of the spinal cord. He obtained cure in 4 cases out of 6 roentgen-irradiated tumors of the spinal cord. An aid in the prognosis of the irradiation is found in the examination of the spinal fluid preceding and two to three days after the irradiation.

Mayer of Vienna reported on his therapeutic and biological observations in carcinomas, which were sensitized to roentgen rays by intravenous injections of hypertonic dextrose solutions. Good results were obtained. The combined treatment is contraindicated only when there exists an acute infectious inflammation of the tumor matrix. In the discussion, Gurniak and Weil reported satisfactory results with Mayer's method. Altschul discussed the researches of Warburg which showed

that the addition of sugar causes an increase in the vitality of carcinoma cells which would seem to indicate a contradiction between these findings and the practical results reported by Mayer. Altschul therefore urged the further study of the problem of carcinoma and diabetes.

ROENTGEN INJURIES

C. Schoenhof of Prague reported her experiments on the question of injury of the embryo or the ova by roentgen rays. The irradiated intrauterine embryo may very probably become injured, consequently artificial abortion is indicated if it is found that irradiation has been administered during pregnancy. Injury to the ovum subsequent to a previous roentgen irradiation seems to be unproven for the present. The author examined a fetus which had received small doses of radiation intrauterinely and had found no injuries of the central nervous system. Pictures were also shown of some children whose mothers had been irradiated with small doses before conception and all these children were normally developed. In the discussion the observations of the author were confirmed by Heimann, Haudek, Wagner and Steiner.

Steiner of Teplitz reported on the effect of exogenic factors upon the development of late injuries as shown in three examples (in one case scrubbing baths, in the second hot air treatment and in the third painting with tincture of iodine for fourteen days).

Rigele of Prague discussed the technique of ray protection in therapy and diagnosis with special reference to the new high capacity installations. Altschul gave a summary of the English proposal for international action regarding radiation protection. Bardachzi proposed a supervision of the social circumstances of roentgen attendants.

DIAGNOSIS

Berg of Frankfurt gave a review of the clinical roentgenology of the upper portion of the duodenum. Ulcer disease has today become the main field for the direct roentgen study of the duodenum. The disease is evidenced by changes in the internal relief (crater formation frequently multiple, elevation and swelling of the mucosa), and when the lumen is tightly filled these signs may disappear more or less. Consequently they must be studied in the relief picture and by tangential transillumination of the organ. Organic involvement of the wall (scar contraction, pocket formation, shortening, stenosis) may be superimposed upon the alterations in relief and to these may be added functional effects such as spasm. Nevertheless, the stenosing effect of the mucosal swelling in the naturally narrow lumen of the duodenum should not be underestimated. The processes occurring in the muscoa undergo distinct change in relation to the periodicity of the disease. The possibilities of discovering incidental participation by adjoining organs (especially the pancreas, bile ducts) give the method considerable importance especially as regards surgical indications, quite irrespective of the improved differentiation from other diseases of the storm center of the upper abdomen. The main subject of the discussion participated in by Haudek, Holzknecht, Porges, Herrnheisser, Ghon, Mahler and Steiner, was the question of spasm versus mucosal swelling.

Zollschan of Karlsbad, discussed peroral cholecystography. He employs capsules hardened in a keratin solution immediately before administration. Special value is attached to the preliminary roentgenogram taken on the day preceding the examination. This latter feature is also endorsed by Herzog of Prague who demonstrated an illustrative case.

Kremer of Kaschau demonstrated roentgenograms of a case of lymphogranulomatosis of the stomach; and in connection with this, Terplan, Herrnheiser and Engel described a case of operated and subsequently irradiated granuloma of the terminal portion of the ileum. Altschul demonstrated the roentgen picture in an ascaris infection.

Reiser of Prague recommends for the roentgen diagnosis of the urinary bladder only small amounts of contrast material (20 to 40 c.c. iodipin) for injection, the remainder of the bladder being distended with air. Roentgenograms taken in 7 cases

with the aid of this procedure were demonstrated. Palugyay of Vienna recommends in this connection his three-plate procedure, that is, a roentgenogram with the contrast material, then the so-called empty roentgenogram following evacuation of the contrast mass and finally a roentgenogram of the air-distended bladder.

THORAX

Assmann, Leipzig, described the relations between the roentgenological and other clinical findings in acute and chronic miliary tuberculosis of the lungs. The roentgen examination is never to be undertaken independently but should be regarded as an admittedly very valuable and, in the case of miliary tuberculosis, an indispensable element of the general clinical examination. In the discussion Haudek mentioned the following points as characteristic: The foci are uniform in size, extremely small and distributed evenly over the whole lung.

Fleischner, Vienna, discussed the isolated infraclavicular focus. Assmann who first called attention to the features of these cases, regards them as caseous pneumonic infiltrations. Fleischner, who has observed extensive regressions, inclines more to the notion that these foci are hematogenous metastases with pronounced perifocal reaction. In the discussion Assmann and Guth opposed the idea of a hematogenous origin, and Haudek discussed the differential diagnosis of these lesions from tumor metastases.

Jaksch-Wartenhorst of Prague had shown in 1923, at the second convention, certain roentgenograms which he had interpreted as cysticercosis of the lung. This patient died six months ago from a rapidly progressing pulmonary tuberculosis. Necropsy disclosed the absence of cysticerci and instead peculiar tuberculous foci inclosed in connective tissue capsules. This is a form of pulmonary tuberculosis which has hitherto been reported as demonstrable only roentgenologically. The author also demonstrated three diapositives of a dermoid cyst of the left lung.

Hofbauer, Prague, demonstrated the pictures of a lung abscess following pneumonia in a child, showing that small children can be roentgenographed not only lying down but also in the upright position despite difficulties. Dvorak, Prague, reported a case of lymphogranulomatosis which had in addition to the mediastinal tumor, foci in the right lung with an apple-sized breakdown cavity. Altschul showed the pictures of 2 cases of calcium plaques in the aorta in young persons without clinical symptoms. In the discussion Herrnheiser suggested the possibility that these might be calcified lymph glands.

DIAPHRAGM

Steiner, of Teplitz discussed the arching of the left diaphragm towards the thoracic space and of local projections caused by abdominal contents and also the subject of hernias below the esophageal hiatus. Reiser, of Prague, demonstrated pictures of a case of dextrolateral traumatic hernia and of a second case diagnosed as right-sided relaxation of the diaphragm. Gurniak demonstrated a case of gastric ulcer in which there was found roentgenologically an interposition of intestines between liver and diaphragm.

BONES

Porges of Prague demonstrated: (1) Roentgen pictures of a case of osteitis deformans Paget of the skull showing alternate compact islands and rarefactions, and (2) a Robert's pelvis contracted on all sides. Jaroschy of Prague demonstrated the roentgen pictures of 4 cases of so-called malacia of the os lunatum, which may be more correctly designated as necrosis. The general recommendation for operation is not justified. Löw-Beer of Prague demonstrated 2 cases of tumor destruction of the thoracic spine which showed considerable resemblance to the pictures of cold, paravertebral abscesses.

Pokorny of Komotau demonstrated (1) a picture with a spherical smooth fragment of bone in the region of the fossa olecrani, which Altschul in the discussion interpreted as a patella cubiti and Reiser interpreted as an exostosis; (2) an excised, chambered rarefaction in the lower portions of the femur, which in the discussion was interpreted by Palugyay and Schiller as enchondroma and sarcoma respectively.

Altschul showed an exostosis of the femur as a sequel to a fracture of the internal part of the epicondyle (Stieda's fracture). Gutig of Witkowitz showed 6 cases from accident practice and demonstrated from them how difficult it is frequently to recognize or exclude the relations of a complaint to accidents. In the discussions Jaroschy called attention to the fact that in tuberculosis an inactive focus must be assumed which may be lighted up by trauma and thus made worse.

PHYSICS

Strauss of Vienna demonstrated his "mekapion" which permits the reading from a dial of the dose delivered up to any moment and thus satisfies the requirements for a suitable dosimeter. Holz and Spiegler of Vienna demonstrated a portable sphere spark gap for the direct measurement of voltage at the tube. Jone of Dresden presented curves for the times of irradiation at various voltages. These show that the hard rays are biologically more effective than the soft.

PHOTOGRAPHIC AND ROENTGENOGRAPHIC TECHNIQUE

Eggert of Berlin reported experiments on roentgen dark room illumination. The new Agfa protective filter 104 was found to be most suitable. Bardachzi and Petrou of Aussig recommend roentgenography upon roentgen paper from which by means of luminography useful copies can be prepared. Russo of Vienna reported experiments on roentgenography at high voltages, which is necessary for restless patients. Franke of Hamburg discussed the possibility of roentgenographing an object always with the same degree of contrast. The radiation can be harder, the thinner the object is, and vice versa, it can be softer, the denser the layers that have to be penetrated. The teleroentgenogram with increased tube voltage has the advantage that the filtering effect of the body on the residual radiation tends to decrease. Since it is not possible because of scattered radiation to make a direct exposure, Groedel moves the cassette 20 cm. away from the body and thus permits the greater portion of undesired scattered rays to dissipate themselves between the body and the plate. A further increase in the contrast effect could be attained by the author by the introduction of a vertical vane between the body and the plate. In the discussion which was participated in also by Reisser and Russo, Jacksch-Wartenhorst pointed out that he had found nineteen years ago in experiments with filtered rays that by the application of metal foils, especially silver foil in roentgenographing under certain conditions one could bring out individual details much better than ordinarily.

WALTER ALTSCHUL.

THE CALDWELL LECTURE FOR 1927

We are informed by Dr. A. H. Pirie, president-elect of the American Roentgen Ray Society, who has charge of the program for the 1927 meeting, that Dr. G. W. C. Kaye will be the Caldwell Lecturer this year. Dr. Kaye is Head of the radium and x-ray department of the National Physical Laboratory, Teddington, England, Past President of the Röntgen Society of London, author of the well-known book "X-Rays," and Hon. Editor of The Journal of the Röntgen Society.

The lecture will be delivered at the annual meeting of the American Roentgen Ray Society at the Mount Royal Hotel in Montreal on the evening of September 21, 1927.

POST-GRADUATE COURSES

Doctor Wetterer, the Editor of "Internationale Radiotherapie," has asked for the publication of the following announcement:

It is intended to publish in the second volume of "Internationale Radiotherapie," all courses given in roentgenology in any part of the world. This should enable everyone interested in post-graduate work to arrange his plans and get further information if desired. All in charge of such courses are requested to please get in touch with Dr. J. Wetterer, Mannheim 0.2, 1, Germany, regarding the insertion of their programs.

Vol. XVII, No. 5

DEPARTMENT OF TECHNIQUE

Department Editor: DAVID R. BOWEN, M.D., Pennsylvania Hospital, Philadelphia, Pa.

In this department will be published from time to time, as material is available, suggestions for improvement in technique.

THE PROFILE ROENTGENOGRAM OF THE OPTIC CANAL

BY HARRY A. GOALWIN, M.D.

Assistant Surgeon, Herman Knapp Memorial Eye Hospital

NEW YORK CITY

ALTHOUGH much attention has been focussed in recent years on the optic canal, the published work on this subject deals exclusively with the roentgen demonstration of the *cross section*. The first mention of the *profile* roentgenography of the optic canal is found in my article on "The Clinical Value of Optic Canal Roentgenograms,"[1] from which the following is quoted:

"The length of the optic canal can be determined from the profile roentgenogram. This view should give us information as to those fractures, which because of their parallel direction to the cross section of the canal cannot be demonstrated on the postero anterior view. It is obvious that an inflamed optic nerve lying within a long canal is more likely to atrophy than one situated within a shorter canal of the same cross section. The likelihood to atrophy, in other words, is directly proportional to the length of the canal and inversely proportional to the size of the cross section."

Martin and Cushing[2] have found in advanced cases of tumor of the chiasm and intracranial portion of the optic nerve a peculiar profile of the sella turcica which they describe as "a recognizable anterior extension of the fossa which passes like the neck of a gourd under the anterior clinoid processes. This is demarcated from the sella proper by the elevation made by the olivary eminence or tuberculum sellae." They ascribe this peculiar outline to pressure enlargement of the optic foramina and destruction of the bridge which separates the sphenoidal fissure from the optic canal.

It is rather strange that as late as 1923, when the roentgenography of the cross section of the optic canal had been described by Schüller,[3] de Kleyn and Stenvers[4] and van der Hoeve,[5] the supposed enlargement of the optic canals in the cases published by Martin and Cushing was not checked up and confirmed by the oblique postero-anterior roentgenogram. If this had been done the authors would have reached the conclusion I arrived at, namely, that the extension of the sella which they describe represents merely a deepened and enlarged sulcus chiasmatis with or without erosion of the under surfaces of the anterior clinoid processes. That it does not represent enlargement of the optic canals I have sufficient proof:

1. In 10 cases in which I demonstrated enlargement of the optic canal by tumor the profile roentgenogram of the sella turcica does not show this deformity.

2. In 3 cases in which I demonstrated destruction of the bridge between the optic canal and the sphenoidal fissure (once by optic nerve tumor and twice by tumor of pituitary) this deformity of the sella turcica is also lacking.

3. A similar deformity (with normal anterior clinoids) is occasionally found in normal cases. I have seen it in the skeleton and in the roentgenogram of the living.

4. This deformity is situated posterior to the optic canals.

A profile view of the optic canal is a lateral view taken at right angles to its axis; in contradistinction to the cross section view which is taken coincident with the axis. Since this axis is inclined to both principal planes of the head (horizontal and vertical), it is evident that a true profile roentgenogram of the optic canal cannot be obtained simultaneously with the true profile of the sella turcica, because the latter is in the median plane of the head. In my previous work[6] I pointed out

that while the cross section of the optic canal can be projected on the roentgenogram in a limited portion of the orbital outlet, the correct shape and size can only be projected at the lower outer angle. It is the fortunate circumstance that the axis of the optic canal is not directed further outward or downward which makes the roentgen demonstration of the optic canal cross section at all possible. For beyond the orbital margin the bone is so dense that the shadow of the normal optic canal walls

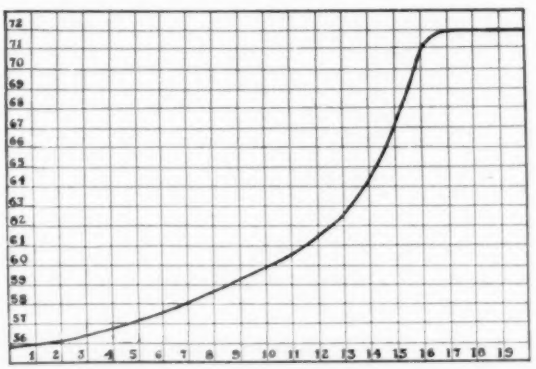

Fig. 1. Curve showing distance of axis of optic canal from lower outer angle of margin of opposite orbit. The age of the patient has been plotted along the abscissa and the corresponding distance along the ordinate.

would be lost in the perimarginal shadow. We are equally fortunate in the fact that the plane passing through the optic canal at right angles to its axis passes also through the orbital outlet of the opposite side. This makes the roentgenography of the profile of the optic canal possible. If we choose to keep the central ray in the plane of the two optic canal axes we obtain a view of the optic canal in which the floor is formed by the bridge separating the canal from the sphenoidal fissure, the roof is formed by the lesser wing of the sphenoid, the outer wall, by the anterior clinoid process and the inner wall by the body of the sphenoid. This is more desirable than keeping the central ray parallel to the horizontal plane of the head, in which case the outer wall would be formed partly by the anterior clinoid and partly by the bridge. As in the demonstration of the cross section, we can make the roentgenogram in the posteroanterior or anteroposterior position. While for the cross section the former is the preferred position, for the profile the latter is to be chosen, the object always being to bring the part to be studied as near the plate as possible.

I anticipated the development of a technique of profile roentgenography of the optic canal when I first began my work on the subject. In my investigations on the skeleton I included therefore certain measurements[7] upon which this technique is based, data by which the actual length of the canal could be calculated from the roentgenographic length and observations upon the average length of the canal in normal adult and juvenile skulls, and in deformed skulls. Some of these data are directly available for the present work, while other data have been worked out from the original records.

The first thing that interests us in the profile roentgenography of the optic canal is the direction of the axis, since we have to place the head so that the axis of the optic canal is parallel to the plate. Measurements on 1000 optic canals (806 in the living[8]) show that the axis is directed downward and outward toward the lower outer angle of the orbital outlet in all normal skulls, adult and juvenile. The plane passing through the axes of the two optic canals is inclined to the horizontal plane of the head, the angle varying in accordance with my curves from 28° at birth to 38–39° at and after seventeen years. In this plane the axis makes an angle with the median line which varies in accordance with my curves from 35.5° at birth to 38–39° at and after seventeen years.

The next thing that interests us is the distance of the axis from the lower outer angle of the orbital outlet of the *opposite side*. My original data gave the distance of the optic canal from the lower outer angle of the orbital outlet of the *same side*, the distance between the two optic canals and the angle between their axes. From these data I reconstructed the plane of the optic canal axes and obtained the measurement desired by dropping a perpendicular to the axis of one side from the apex opposite to it. This distance, which I designate as "Y", varies from 56 mm. at birth to 72 mm. at and after seventeen years, in accordance

with the curve plotted in Figure 1. This perpendicular strikes the axis within a distance of 5.0 mm. anterior to the posterior end of the canal.

The average length of the optic canal in the normal adult skull is 4.3 mm., the maximum being 8.0 mm. and the minimum 0.0 mm.

The technique for obtaining the profile roentgenogram of the optic canal can now be given. We shall consider first the adult: The horizontal and median planes are marked on the capped head as described in connection with the roentgenography of the cross section. The patient is placed on his back, face directly up. The head is then turned on a transverse axis until the horizontal plane makes an angle of 52° with the plate, the angle being open cephalad. This places the plane of the optic canal axes perpendicular to the plate. We now turn the head toward the side to be investigated, keeping the former plane perpendicular to the plate, until the median plane makes an angle of 38° with the plate. The axis is now parallel to the plate and the orbit to be investigated is nearest the plate. The tube is now set with the central ray pointing to the lower outer margin of the orbit of the opposite side, that is, of the orbit which is furthest from the plate, and the exposure made. As in all my cranial roentgenography, the plate is horizontal and the central ray is vertical.

If the patient is under seventeen years we substitute $90 - \alpha$ for the first angle given (52°) and β for the second angle given. It will be remembered that α is the inclination of the plane of the axes of the optic canals to the horizontal plane and β is the angle which each axis makes with the median plane, when measured in the first plane.

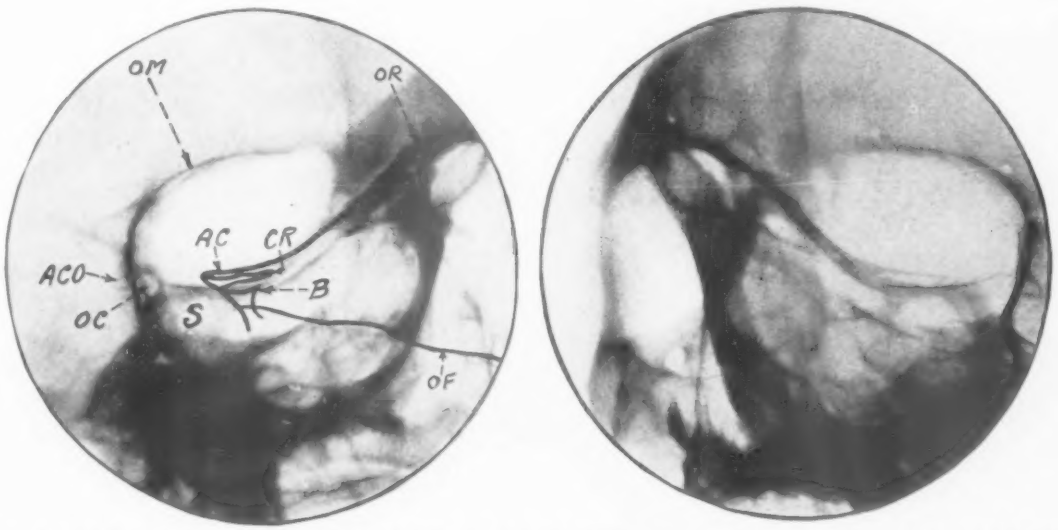

FIG. 2. Profile roentgenograms of the optic canals of a dried normal skull. The roentgenogram of the left side has been intensified and labeled:
OR—orbital roof; OF—orbital floor; AC—anterior clinoid process; CR—roof of optic canal; B—bridge between optic canal and sphenoidal fissure; S—sphenoidal sinus; OM—orbital margin of opposite side; OC—distorted cross section of optic canal of opposite side; ACO—anterior clinoid process of opposite side.

For purposes of calculation the focus-plate distance should be measured (represented by "a" in the formula below), and the distance from the lower outer angle of the orbital margin of the side which is furthest from the plate (represented by "B" in the formula). If "L" is the roentgenographic length of the optic canal, "l" the actual length and "Y" the distance of the axis from the lower outer angle of the orbit of the opposite side, then the following modification of the formula given for the cross section of the optic canal obtains for the profile:

$$l = L - \frac{B - Y}{a}(f + L)$$

"f" being the average diameter of the focal

spot and "y" being obtained from the curve given above, as it depends on the age of the patient.

In making the placement of an oxycephalus it should be remembered that the average value of the angle α in these cases is 15.6° and the average value of β is 41.5°. The first rotation is therefore made with the median plane perpendicular to the plate until the horizontal plane makes an angle of about 75° with the plate, and the lateral rotation is made until the median plane has an inclination of 41° to the plate. The average "y" distance in these cases is 6.1 mm., hence the formula for calculating the length in an oxycephalus becomes:

$$l = L - \frac{B-6.1}{a}(f + L)$$

In these cases the central ray should be aimed at the *center* of the opposite orbit.

When dealing with other skull deformities it is best to determine the direction of the axis of each optic canal and the other necessary data in advance. This can be done from a complete set of orbital roentgenograms which should include at least posteroanterior, lateral and axial views and the cross sections of the optic canals.[9]

The average length of the optic canal in oxycephaly as obtained from 14 cases measured, is 6.1 mm., the maximum being 10.0 mm. and the minimum 5.0 mm. It will be noted that while normal cases are encountered in which the optic canal has no length, hence is truly a foramen, no oxycephalic canal was observed with a length under 5.0 mm.

The interpretation of the profile roentgenogram of the optic canal is greatly facilitated if we remember that what we are practically dealing with is a lateral view of the orbit, taken in such a manner that the outer orbital wall is parallel to the plate. We should further remember that the atomical conditions are such that in this lateral view of the orbit the apex is projected into the area enclosed by the orbital outlet of the opposite side. If we take therefore the profile roentgenogram of the right optic canal (Fig. 2, R) we see at the extreme left of the picture an oblique outline of the orbital margin of the right side. At the upper and lower portions of this orbital margin we see the anterior parts of the roof and floor of the right orbit. The outline of the roof is more distinct than that of the floor. Both outlines (roof and floor) extend to the right of the roentgenogram, where they enter the projection of the orbital margin of the left side and end in the profile outline of the right optic canal. About 2 cm. to the right of this profile roentgenogram of the right optic canal is a distorted anteroposterior view of the cross section of the left optic canal. Although the latter structure is more sharply outlined than the structure under

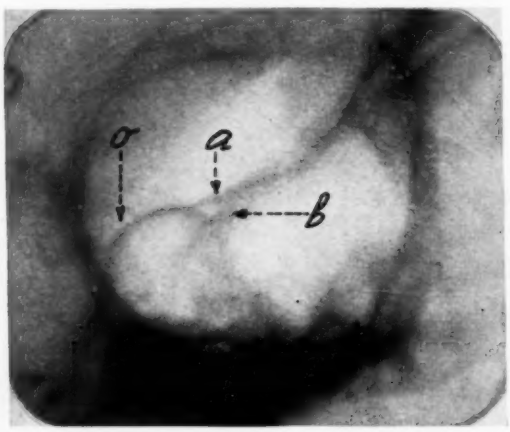

Fig. 3. Profile roentgenogram of optic canal in oxycephalus, dried specimen: *a*—anterior clinoid process; *b*—bridge between optic canal and sphenoidal fissure; *o*—distorted cross section of opposite optic canal.

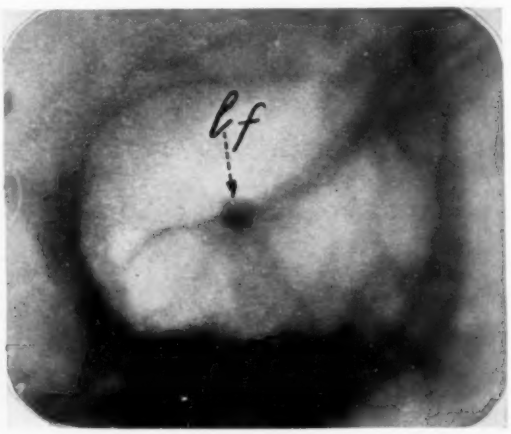

Fig. 4. Same as Figure 3, but with lead foil in optic canal (*lf*).

investigation it is of no diagnostic value. Turning again to the profile of the optic canal in question (right), we can make out very distinctly the anterior clinoid process, the bridge which separates the optic canal from the sphenoidal fissure and the posterior extremity of the roof of the optic canal, which latter is also the posterior extremity of the roof of the orbit.

If we take a point midway between the roof and floor of the optic canal and connect it with the lowest point of the outline of the orbital margin of the same side by means of a straight line, we have obtained the axis of that optic canal. It is along this axis that the length of the optic canal is measured. As I have pointed out,[7] the length of the optic canal is that part of it which is surrounded entirely by bone. In the normal skull the posterior end of the roof is situated anteriorly to the posterior end of the floor. The length of the optic canal in a normal skull is therefore obtained by dropping a perpendicular to the axis from the posterior end of the roof and measuring the distance from the foot of this perpendicular to the foot of a similar perpendicular dropped from the anterior end of the floor. If they coincide the optic canal has no length. If the former is posterior to the latter the length is positive. If the former is anterior to the latter the length is negative. The optic canals of which the profiles are shown in Figure 2 have a negative length. Such a condition is most favorable in the presence of inflammation of the periosteum or the nerve itself, or in the presence of increased intracranial pressure. The reason is twofold: (1) the actual transverse area available for the optic nerve is greater than that represented by the roentgenogram of the cross section, and (2) there is room for swelling of the nerve in front and behind the canal, hence pressure atrophy should be delayed.

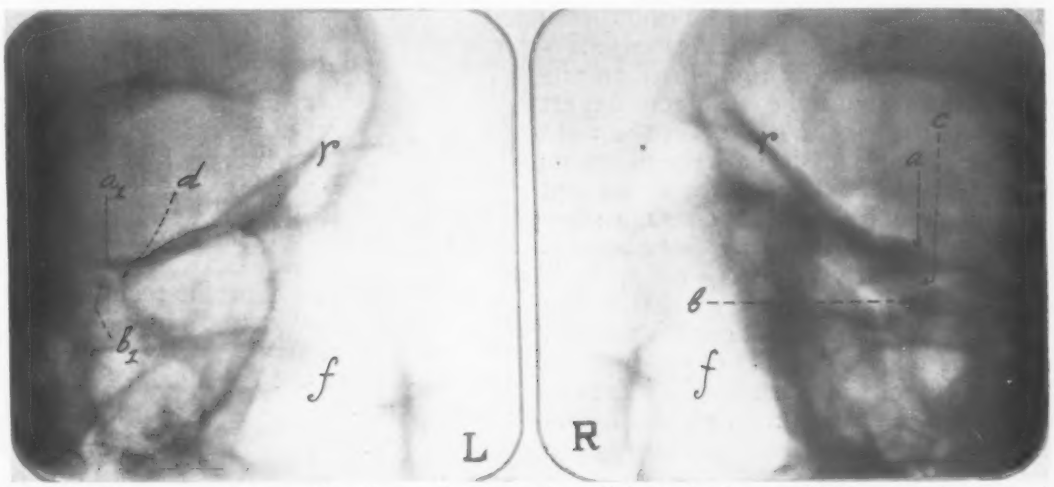

Fig. 5. Profile roentgenograms of optic canals of a patient (living) who has partial hyperostosis of the right sphenoid; a, a_1—anterior clinoid process; b, b_1—bridge between optic canal and sphenoidal fissure; c—profile of optic canal lumen, right; d—roof of optic canal, left; r—orbital roof; f—orbital floor.

In oxycephaly, plagiocephaly and scaphocephaly the condition is different from the normal as regards the length of the optic canal. Here the posterior end of the roof is posterior to the posterior end of the floor. The length of the optic canal in these skulls is therefore equal to the length of the bridge which separates it from the sphenoidal fissure, the measurement being taken parallel to the axis of the optic canal. This condition is represented in Figure 3 which is a profile roentgenogram of the right optic canal of an oxycephalus. Here we identify the same anatomical details as in the previous roentgenograms, except the notch which indicates the anterior position of the posterior end of the roof. The roof in this case extends as far back as the apex of the anterior clinoid process.

The roentgenographic appearance of the structures described is definite and

uniform. It is the same in the roentgenogram of the living as in the roentgenogram of the dried skull. No further proof of their identity is therefore necessary to one who is thoroughly familiar with the anatomy of this region. In order to dispel any possible doubt, however, I introduced a piece of lead foil into the optic canal represented in the previous roentgenogram, and obtained the picture represented in Figure 4.

In proceeding to the profile roentgenogram of the optic canal in the living (Fig. 5), we are fortunate in having for illustration a case in which one optic canal (left) is normal and the other (right) is pathological. We see here on the left side a picture which is almost the exact counterpart of the one seen in Figure 2. On the right side the condition is entirely different: The anterior clinoid process is dense and thick. The roof of the canal does not show the notch seen on the left side because it extends posteriorly as in the oxycephalic canal. The bridge which separates the canal from the sphenoidal fissure is thicker, denser and longer than that of the opposite side. Its length, which is also the length of the optic canal, is 9.0 mm. on the roentgenogram, while the length of the opposite canal is only 1.5 mm. on the roentgenogram. We are dealing here with a marked hyperostosis of the apex of the right orbit, due, in my opinion, to an endothelioma of the optic nerve sheath.[10] It is in such cases, where the canal is extremely long and its walls extremely thick and dense, that the greatest possible precision is required to demonstrate the true cross section. The slightest deviation from the correct position will produce an apparent constriction of the optic canal. As a matter of fact, constriction of this (right) optic canal was reported by a previous examiner, while later roentgenograms showed it to be normal in size.

This anatomical condition of the optic canal, as well as the condition described in the deformities of the skull, is the least favorable in the presence of inflammation of the periosteum or the optic nerve itself, or in the presence of increased intracranial pressure. In the deformed skulls the associated constriction of the cross section makes conditions still worse.

SUMMARY

1. A profile roentgenogram of the optic canal is a view taken at right angles to its axis, in contradistinction to the roentgenogram of the cross section which is taken coincident with the axis.

2. Since the axis of the optic canal is inclined to both principal planes of the head, the true profile of the optic canal cannot be obtained simultaneously with the true profile of the sella turcica.

3. A true profile roentgenogram of the optic canal is obtained by placing the patient's head on the horizontal plate, facing up and toward the side to be studied, the horizontal plane of the head making an angle of 52° with the plate and the vertical plane of the head making an angle of 38° with the plate, the central ray being kept vertical and pointing to the lower outer angle of the orbital margin of the opposite side.

4. On the typical profile roentgenogram of the optic canal its roof, anterior clinoid process and the bridge which separates the canal from the sphenoidal fissure can be identified.

5. The profile roentgenogram of the optic canal is of value in determining the length and other normal and pathological details, transverse fractures, hyperostoses, etc.

6. The peculiar shape of the sella turcica which was found by Martin and Cushing in tumor of the chiasm and intracranial portion of the optic nerve is not due to enlargement of the optic canal or destruction of the bridge which separates it from the sphenoidal fissure.

7. A long optic canal is unfavorable in the presence of pathology in it, particularly when its cross section is small.

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INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

Andersen, Ernst. Right-sided elevation of the diaphragm. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, February, 1926, xxxiv, 347–349.

A report is given of a case occurring in a woman aged forty. The roentgenographic examination showed the usual picture of elevation of the diaphragm. The patient had suffered a good deal from pulmonary catarrh during childhood. The small calcified foci in the right hilus seen in the roentgenogram indicate with fair certainty the existence of a previous hilus tuberculosis. Undoubtedly hilus disease in children may lead to a neuritis of the phrenic nerve, ultimately to atrophy, so that in the present case there is no need to regard the elevation of the diaphragm as idiopathic. This matter can however be decided only at autopsy with a careful examination of the phrenic nerve.

Andersen, Ernst. Anomalies of the spinal column and the ribs. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1926, xxxiv, 491–499.

It is estimated that among the hundreds of patients appearing for roentgenographic examination of the thorax about 30 per cent possess anomalies of the vertebral column and the ribs. The slighter anomalies produce no symptoms and have no clinical significance. Embryologically such cases are very important; and the roentgenologist has more opportunity for observing them than the anatomist. Two cases of cervical ribs are described. Variations are frequently noted in the first rib. The roentgenogram frequently discloses shortening or narrowing and in many cases the first ribs are more vertically placed so as to constrict the upper thoracic aperture. Four such cases are discussed. Not only are various exostoses present, but occasionally articulated junctions may be established between the ribs of the eighth and ninth vertebrae. This joint is usually formed between the middle of the small curvature of the second rib and the bony portion of the greater curvature of the first rib. In all such cases the first rib is somewhat smaller and seems to be more steeply inclined. The ventral portion of the first rib which forms the joint with the second rib is always found to be somewhat broadened. The possible connection between such anatomical anomalies and tuberculosis is self-evident.

In addition to the above there is a description of a case of articulation between the 1st rib and the clavicle. Quite frequently there have been observed bifurcations of the sternal ends of the third, fourth and fifth right ribs. Two such cases are described. In one of these the patient also had only eleven pairs of ribs, a dorsolumbar transitional vertebra and a sacralization of the last lumbar vertebra.

Arens, Robert A., and Bloom, Arthur R. A case of abdominal pregnancy. *Radiology*, July, 1926, vii, 65–66.

A woman aged thirty-six was admitted complaining of severe pain in the lower abdomen and of vaginal bleeding. The roentgenograms of the abdomen disclosed the presence of fetal structures, the entire skeleton being clearly visible. The fetus was of about four and a half months of age, and instead of lying within the pelvis it was found in the right iliac fossa extending above the iliac crest. The head and neck appeared sharply flexed upon the spine, suggesting skeletal collapse. From its size and location it appeared to be an abdominal pregnancy.

At operation an almost black amniotic sac was seen lying free in the abdominal cavity. This was ruptured, and a macerated, partly desiccated fetus measuring 26 cm. in length was removed. This case is undoubtedly one of primary abdominal pregnancy in which the fetus had gone to about four and a half months.

Arkin, Aaron. Calcified hypernephroma of the kidney. *Surg., Gynec. & Obst.*, August, 1926, xliii, 155–168.

Hypernephroma is a not uncommon tumor of the kidney found quite frequently on postmortem examination. Most hypernephromas probably originate from misplaced adrenal rests. They may remain benign for years and then assume malignant characteristics. Rarely are malignant hypernephromas found in children. The malignant form is characterized by a special tendency to invade the renal vein and produce metastases in the osseous system and lungs. A solitary metastasis is no contraindication to operation for its removal together with the primary growth may result in cure, or years of good health.

The slow growth of some hypernephromas is

accompanied by marked degenerative changes with pseudo-cyst formation, hemorrhages and pigmentation, hyaline changes, calcification, and even metaplasia to bone tissue. Some of the so-called cysts of the kidney are degenerated hypernephromas. Every case of hematuria in a person past middle life should suggest the possibility of hypernephroma when no other cause can be found.

The roentgenogram is of considerable value in the diagnosis of kidney tumor and in its differentiation from other renal disease which produce shadows in the kidneys. The examination may be made by (1) roentgenography of the kidneys; (2) pyelography; (3) with the aid of pneumoperitoneum; (4) with the aid of perirenal injection of oxygen, and (5) by examination of the colon and stomach for dislocation. The roentgen findings are very variable. A small tumor will, as a rule, give no positive findings unless it is calcified. The larger tumors are characterized by a more or less irregular or nodular shadow which becomes continuous with the kidney shadow or occupies the kidney region. Tumors of the upper pole are more difficult to demonstrate than those in the lower pole. Occasionally a tumor presents the picture of a stone, when it is calcified or when a calcified blood clot is present. In establishing the roentgenological diagnosis of hypernephroma the following conditions must be differentiated: (1) tuberculosis of the kidney; (2) hydronephrosis and pyonephrosis; (3) perinephritis; (4) paranephritic abscess; (5) cystic kidney; (6) calcified blood clot in the pelvis; (7) bilharziasis; (8) calcified aneurysm of the renal artery; (9) tumors of the kidney, and (10) calculi.

A case of calcified and partly ossified hypernephroma of the left kidney producing gastric symptoms in a woman aged forty-six is reported. The case is of special interest because of its long duration (sixteen years) and the striking roentgen findings. The roentgenogram showed surrounding the entire ellipitical tumors shadow a distinctly calcified shell varying in thickness from 1 to 4 mm. This shell consisted of linear and punctiform shadows, interrupted here and there by areas of the capsule which contained little calcium. Throughout the entire tumor mass there were distinct and indistinct irregular small shadows of calcification assuming a definite arrangement in many parts of the mass. The shadows formed round or oval areas containing less distinct spots and small irregular calcium deposits. These gave the tumor a lobulated appearance forming a network of calcified masses separating small and large clearer spaces. This picture is characteristic of a tumor of the scirrhous type.

Bellucci, Bruno. Chronic osteoarthropathy of the spinal column from the point of view of roentgen examination. *Arch. di radiol.*, July-Aug., 1926, ii, 485–533.

Roentgenography gives even a better picture of changes in the spinal column than post mortem examination because there are no post mortem changes. As a result of roentgen examination it has been possible to group the various diseases of the bones and joints of the spinal column into a few quite clearly defined groups while there was great confusion under the old method of grouping them according to clinical symptoms. Of course there are transition types that make a careful study of the clinical symptoms necessary in connection with the roentgen picture.

The chief groups of chronic spondylitis are those of known etiology (tuberculosis, syphilis, trauma, neuropathy) and two groups of unknown origin, the deforming and ankylopoietic. In traumatic spondylitis there is a history of trauma some months or possibly even some years before. The spondylitis is quite strictly limited to the injured vertebrae and there is no osteophytosis of other vertebrae. There may be fractures, luxations, subluxations or bone callus which remove all doubt of the traumatic etiology. Traumatic spondylosis may also assume the form of traumatic kyphosis described by Kümmell and Henle. There are attacks of pain alternating with free periods and a kyphosis with a large arch, the vertex of which is sensitive to pressure.

The most characteristic feature of tuberculous spondylitis is Pott's deformity. There are also the parrot's beak osteophytes, but these are not specific; they are found in various forms of chronic spondylitis. Chronic syphilitic spondylosis is rather rare. It shows a condensing osteitis with hypertrophy of all the bone, while in the tuberculous form there is rarefying osteitis with diffuse decalcification and atrophy of bone. In the syphilitic form there is almost always a periosteal reaction which is hardly ever seen in the tuberculous form and the fungosities which are practically always present in the tuberculous form are never seen in the syphilitic form.

Chronic neuropathic spondylosis is also rare. It may occur in tabes, syringomyelia or Parkinson's disease but is most frequently seen in tabes. In spondylosis from tabes the lumbar column is most frequently affected while in the syringomyelic form the cervical column is generally affected. While this form of spondylosis may cause great deformity of the spinal column it rarely causes pain or signs of compression of the spinal cord. There is

flattening of the vertebrae and osteoporosis. The articular surfaces are very irregular. The greatest change in tabes is generally in the 3d and 4th lumbar which are reduced to the form of cones; there is generally great deviation of the spinal column. There are frequently queer hypertrophic lesions in the form of osteophytes, exostoses, bridges and calcareous masses which may be detached from the spinal column and form free fragments. In this form of spondylosis there is both atrophy and hypertrophy with the former predominating.

Of the two primary forms of spondylosis, spondylosis deformans almost always affects subjects more than forty years of age and the two sexes about equally, while ankylotic spondylosis is almost always in young men. Sponddlitis deformans affects only parts of the spinal column, most frequently the lumbar segment and there are changes in both the bodies of the vertebrae and the intervertebral discs. The discs are atrophied and sometimes disappear completely so that the bodies of the vertebrae are in contact with each other. There is hypertrophy and thickening of the bodies of the vertebrae and the margins protrude, forming bridges and parrots' beaks. Sometimes these osteophytes are branching or in the form of fungi. There are also signs of osteoporosis in the form of clear spots irregularly distributed. There are no signs of uniform total decalcification and malacia such as are seen in rhizomelic spondylosis. There is ossification of the articular ligaments but never ankylosis.

The ankylotic form begins in the intervertebral joints and is inflammatory in nature as distinguished from the form described above which is purely degenerative. It generally affects the whole spinal column. The bodies of the vertebrae are normal in form and height and only show excessive transparency due to osteoporosis. There are no osteophytes. The intervertebral discs are normal.

In illustration of some of the above points the author describes 5 clinical cases with roentgenograms. Three were cases of tuberculous spondylosis, one of syphilis and the other probably traumatic, although it was impossible to make an absolutely definite differentiation between that and primary chronic spondylosis. In 3 of his 5 cases there was sacralization of the 12th dorsal vertebra. He thinks defects of this kind are not necessarily congenital but may be caused by changed static conditions in the spinal column due to pathological causes. He believes that the bridge-like osteophytes are a defense measure designed to immobilize the spinal column and so put it in the best position for healing. This explains why osteophytes sometimes develop at a distance from the pathological focus in the spinal column.

BELLUCCI, BRUNO. Vesicorenal reflux. *Arch. di radiol.*, July-Aug., 1926, ii, 534–552.

Incontinence of the ureteral valve with a reflux of urine into the kidney has been demonstrated definitely only since roentgen examination of the bladder was introduced, although it was suspected clinically before. It may be due to inflammation of the urinary tract or to spinal cord lesions. The author describes a case in a young woman aged twenty-three with inflammation of the bladder which was demonstrated by pyelography. Following this he performed experiments on human subjects to see whether this reflux could be brought about artificially. His idea was to bring about temporary paralysis or paresis of the musculature of the bladder and ureters. In one group of cases he filled the bladder with a contrast substance to which novocain and atropin had been added. In a second group he distended the bladder with contrast liquid during anesthesia and in a third group he practiced cystography after spinal anesthesia at the level of the 4th to 5th lumbar vertebrae. He presents pyelograms of the cases, showing reflux of liquid into the ureter; he did not try to continue it into the kidney pelvis as he did not want to produce any unnecessary traumatism. In some cases the reflux was unilateral, in others bilateral. The production of reflux was most successful in the cases under general anesthesia; lumbar puncture was less effective.

He suggests this as a possible method of examining the kidney pelves without catheterization of the ureters. He thinks the traumatism would be as little or less than that of catheterization of the ureters and besides there are many cases in which the latter is impossible for various reasons. The objection that bacteria may be carried from the bladder into the kidney is not valid because the same thing may happen in catheterization of the ureters. The disturbances caused by bilateral reflux are the same as those seen in bilateral pyelography. The danger of rupture of the bladder from over-distention can be avoided by filling it under screen control. He intends to continue the experiments using antipyrin anesthesia of the bladder.

BELLUCCI, BRUNO. Anatomico-roentgenological study of an unusual congenital deformity of the feet. *Arch. di radiol.*, July-Aug., 1926, ii, 553–560.

The patient was a woman aged thirty who had been treated for years for a serious psychosis. There was no history of anomalies of the

bones or viscera in the family. Each of her feet had only two large deformed toes with dystrophic nails. These toes were very long as the interdigital spaces were prolonged to the bases of the metatarsals. The toes were held in a position of slight semiflexion and were twisted on their axes so that when the patient was standing their tips were very close together, and those of the right toes even touched, leaving a large triangular space formed by the interdigital and intermetatarsal spaces.

The roentgen picture of the right foot showed two groups of two metatarsals each. The 1st and 2d metatarsals appeared normal except that the first was much smaller than normal and they articulated normally with the 1st and 2d cuneiform. The 3d metatarsal was evidently formed by fusion of the third and fourth. Its proximal end showed a sort of bifurcation, one side of which articulated with the 3d cuneiform and the other with the surface of the cuboid which normally articulates with the 4th metatarsal. The external one was a normal 5th metatarsal. There were only two toes, one on each side. There were a number of sesamoid bones between the 1st and 2d metatarsals. The roentgenogram of the left foot showed an internal group of two metatarsals and an external one of three. The 1st metatarsal here was small too. The third metatarsal ran almost to a point by which it was attached to the end of the 4th metatarsal. There was a well-developed joint surface between the 2d and 3d metatarsals. A single large phalanx with two joint surfaces at its base articulated with the first two metatarsals. On the external side there were two proximal phalanges and two ungual phalanges articulating with the 4th and 5th metatarsals. The bones of the 2d and 3d toes were entirely lacking. The phalanges of the last two toes were entirely distinct but they were covered with common soft parts so that externally they looked like one large toe, with a single nail.

Roentgen examination of the skull showed a small sella turcica of an infantile type, and as there was no hereditary factor the author concludes that the anomalies of the feet were due to dysfunction of the hypophysis.

Bellucci, Bruno. Two cases of inguinal fistula, one communicating with the sigmoid colon and the other with the bladder. *Arch. di radiol.*, July-Aug., 1926, ii, 561–568.

The first patient was a young woman of twenty-two who at seventeen had had an exudative pleurisy and about three years ago an attack of abdominal pain with high fever. Her physician made a diagnosis of peritonitis, prescribed local applications and in two weeks she was well. In a few months she began to have general malaise and evening rise of temperature which was thought to be due to an apical lesion. In May, 1925, a swelling developed in the left inguinal region which increased in size until it was as large as an orange. It was opened and a large amount of pus discharged, but she did not improve; the fistula continued to secrete and her temperature remained around 38° to 38.5°. She was sent to the author in March, 1926. Examination showed a lesion of the right apex and intense and uniform opacity of the left base. A roentgenogram of the pelvis and spinal column made because he suspected a bone abscess, was entirely negative. Barium sulphate was then injected into the fistula and the roentgenogram showed that the tract communicated freely with the upper part of the sigmoid. The barium outlined the whole course of the sigmoid and had collected in the terminal part of it. There had never been any discharge of gas or feces from the fistula. The primary disease had probably been a circumscribed peritonitis following specific ulcerative colitis. A localized abscess developed which slowly made its way to the skin through the muscles of the abdominal wall. There were probably folds in the fistulous tract which made it possible for the contrast liquid to flow inward but which prevented feces or gas passing outward.

The second patient was a young woman of twenty-three married at nineteen who had never been pregnant. About eighteen months ago while she was in good health a swelling the size of an olive suddenly appeared in the right inguinal region. She had frequent desire to urinate, only a small amount of urine was passed and she had a burning pain during and after micturition. The urine was turbid. About two months after it appeared the inguinal swelling opened spontaneously and a yellowish white liquid was discharged. The ulceration healed but broke down again and this happened three times before she came for treatment in December, 1925. At that time micturition was normal and the urine clear. She had never had fever except for a period of about fifteen days the preceding summer. Urine had never been passed through the fistula. Injection of contrast fluid however showed that the fistula communicated with the bladder. At the upper pole the bladder communicated with two irregular cavities which were connected with each other and with the fistula. Operation showed that the fistula had originated from an abscess of the left adnexa.

Benjamin, A. E. Gastric and duodenal ulcers, with report of unusual cases. *Journal-Lancet*, July 1, 1926, xlvi, 300–305.

Accurate diagnosis of gastric and duodenal ulcers is possible in perhaps 90 per cent of the chronic cases. When the clinical symptoms are well defined and a chemical analysis thoroughly studied, a roentgenogram confirms the diagnosis in nearly all ulcer cases in which there is any break in the mucous membrane with involvement of the muscular layer. An imperfect cap is usually found where the duodenum is involved; however, one must take into account a possible gall-bladder disease or adhesions that might produce a deformity. No case should be neglected or fail to receive the diagnostic knowledge obtained from this relatively accurate method. There are still too many patients who are not given the advantage of a roentgen diagnosis because of the expense to the individual. It seems necessary that physicians and surgeons in some way should make it possible for every patient, rich or poor, to obtain this necessary and early roentgenographic examination. An early diagnosis and a proper supervision of small ulcers in the incipient stage will go a long way to obviate serious consequences.

With our present knowledge of the disease, we must encourage patients to have all possible foci of infection removed or treated. The early symptoms leading up to ulcer must be recognized and corrected. Six cases are discussed and described.

Bennett, T. Izod, Moncrieff, Alan, and Nicholas, F. G. Observations on cholecystography. *Lancet*, July 3, 1926, ii, 19–21.

The authors have employed tetraiodophenolphthalein (iodeikon) by oral administration with good results. The dye was given in formalinized gelatin capsules which must be freshly prepared, because if kept for more than twenty four hours they become too tough for proper digestion. A brief analysis of 58 cases is given.

The importance of taking a roentgenogram before administration of the dye has not hitherto been sufficiently emphasized. The gall bladder may give a definite shadow in this preliminary plate. If after administration of the dye there is no increase in the density of this shadow, it is evidence that no dye has entered the gall bladder. Certain other shadows such as those of renal calculi, etc., may also be present and are less likely to lead to erroneous deductions if seen clearly in the preliminary plate. When definite gallstone shadows are seen before the administration of the dye, there is no need to continue with cholecystography. But if certain vague shadows in the preliminary plate are seen to coincide with a patchy gall bladder shadow after administration of the dye, it is strong confirmatory evidence of their nature.

It is most important to observe the alimentary canal and especially the cecum for the presence of unabsorbed dye. The importance of securing proper absorption of the dye cannot be overestimated. In examining the shadows of the gall bladder attention should be given to the variations in size and density on the series of films. A healthy gall bladder may cast a surprisingly large shadow, but there should in the second film be a distinct diminution in this size with an increase of density due to concentration of contents and contraction of the walls of the gall bladder, which are the normal functions of the non-infected organ.

Bergamini, Marco. Foreign body (screw) in the digestive tract of an infant. *Radiol. med.*, November, 1926, xiii, 788–789.

Bergamini describes the case of an infant six months of age who swallowed a screw which had fallen into its mouth. The screw was passed with the stool thirty-eight hours later without having caused any symptoms and without causing any after-effects. He followed its course through the digestive tract by means of roentgen rays and found that food passes quite rapidly through the digestive tract of infants of this age. Other cases have been reported in which foreign bodies have been passed without any injury. In such cases the foreign body should be followed up by roentgen-ray examination and nothing done as long as it passes normally. No manipulations should be made to hasten its passage and no surgical intervention attempted. Sweetened gruel may be given to facilitate the passage of the foreign body but purgatives are dangerous.

Bernstein, Arnold. Obstructions in the duodenum. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, February, 1926, xxxiv, 245–252.

Five cases are reported in which there was interference with the passage of material through the duodenum and in which no mechanical cause of stenosis could be demonstrated or could suffice to explain the condition. The symptoms observed were characterized by a much prolonged stay of the contrast material in the duodenum or certain portions of it, and increased shadows in the dependent portions of the duodenum. The severer forms of these cases may be very similar to true duodenal stenosis.

These cases are explained as being due to disturbance of the normal duodenal function and as having a causal relationship to diseases of the duodenum itself or of adjacent organs. The recognition of functional obstruction of the duodenum is important first in the differential diagnosis of true stenosis, and second, in that

it indicates some pathologic organic process in the duodenum or in its near vicinity. The latter may be due to (1) an increased output of the stomach followed by a failure of the duodenum to accomplish the increased work; (2) failure of the pyloric reflex or presence of an open pylorus; (3) disturbance in peristalsis; (4) disturbances in normal function of the mucosa due to pathological conditions within it.

A characteristic roentgen picture in these cases shows the contrast material which normally traverses the duodenum in a few seconds to take several minutes to pass through the duodenum. In practically all of the cases there could be observed a to-and-fro movement of the contents. A re-examination after two hours usually discloses a considerable shadow formation in the dependent portions of the duodenum. In all of the cases that were operated on extensive periduodenal adhesions were found but no actual stenosis. Occasionally there was an actual narrowing in the upper portion of the duodenal lumen, but the interesting thing is the fact that the picture of obstruction seen roentgenographically included the whole length of the duodenum.

Blum, Robert. The roentgenographic differential diagnosis of chronic infiltrative pulmonary diseases. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1926, xxxiv, 512–516.

A case is described of chronic infiltration of the upper lobe of the left lung in a man aged forty-four. The disease followed a course resembling very much bronchial carcinoma. Two roentgenograms taken four weeks apart showed a distinct increase in infiltration in a triangular hilus shadow such as is frequently seen in cases of bronchial carcinoma. Except for an acute bronchial catarrh occurring eight years previously and continuing as a chronic bronchitis since then, there was nothing else to be learned from the anamnesis; and a chronic pneumonia had to be taken into consideration in making the differential diagnosis. At post mortem examination the case proved to be one of true primary chronic pneumonia with extensive hepatization and involvement of the pleura and pericardium. The experience in this case shows that it may be impossible at times to differentiate between tumors of the lung and chronic pneumonia even roentgenographically.

Boehm, Gotfried, and Kühne, Otto. The lung infarct in the roentgenogram. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, February, 1926, xxxiv, 302–307.

A report is given of a case occurring in a woman aged forty-one who developed, as the result of an operation for myoma, a latent thrombosis of the pelvic vessels without the accompaniment of Mahler's sign. There developed eight days later a pulmonary embolus which was not localizable clinically. After four more days there occurred a renewed increase in temperature and stabbing pains, and an infiltration was detectable over the right lower lobe. This was interpreted as an inflammation up to the lung surface involving the region of the infarct. The roentgen examination disclosed the first postoperative condition, namely, infarct of the right upper lobe which was not detectable by percussion or auscultation. The roentgen examination during the second attack could not distinguish between bronchopneumonia or second infarct. The roentgenogram in the first instance disclosed a pathological-anatomical basis for the development of the classical pulmonary infarct by demonstrating blood stasis as a primary condition.

In this case, the infarct was associated with pulmonary stasis which later became complicated by a bronchopneumonia. The lung condition healed completely after four months. The roentgenograms in the beginning showed a pyramidal shadow with very distinct margins. Since these shadows disappeared after healing, it may be regarded as demonstrating that lung infarct may heal without leaving any roentgenographic traces.

Bokor, Georg A. Esophageal diverticulum associated with duodenal ulcer. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, February, 1926, xxxiv, 345–346.

A report is given of a case occurring in a man aged twenty-five. The roentgen examination disclosed, in addition to the typical duodenal picture of ulcer, a small esophageal diverticulum approximately at the level of the bifurcation. The diverticulum occasioned no symptoms and was discovered only incidentally to the usual roentgen examination.

Attention is directed to the fact that similar incidental findings of diverticulum of the esophagus have been noted by the author rather frequently in cases suffering from gastrointestinal disease. The question therefore arises, is there some relation between the duodenal ulcer and the small esophageal diverticulum in the present case? While a definite answer in the affirmative cannot be made at present in view of our limited knowledge, it is nevertheless important to recognize that these two conditions can often be found associated and may possibly indicate a relationship between the two.

Bonaccorsi, A. The splenic flexure of the colon in splenomegaly. *Radiol. med.*, December, 1926, xiii, 889–910.

Bonaccorsi describes 19 cases of splenomegaly with roentgenograms and finds that splenomegaly almost always causes changes in the site, form, and course of the splenic flexure of the colon as a whole or one or the other of its limbs. The increased weight of the spleen stretches the ligaments, particularly the left phrenocolic ligament and this causes changes, the degree of which depend on constitutional, anatomical and topographical factors and on the time required for the development of the enlargement of the spleen. The changes are most marked in the most chronic form of splenomegaly, that due to malaria. In all cases of malarial splenomegaly he found a marked lowering of the flexure and a displacement of it toward the midline, and often a superolateral curvature of one of the limbs of the flexure and variations from the normal in the degree of the angle. But in splenomegalies which develop in a relatively short time the spleen is not able to stretch the ligaments of the flexure and so it has to follow its own weight and slip almost out of its bed in the only direction open to it, and lie in front of the colon. In these cases the flexure is not greatly lowered and instead of being displaced toward the midline it is displaced laterally; the curvatures have a median concavity and the angle remains acute. There are other diagnostic points in these cases, such as the change in depth of the colon, the impossibility of emptying the colon of barium at any desired point by palpation and manual pressure, its displacement toward the side and sometimes flattening of the flexure against the lateral wall of the abdomen. There are intermediate stages between these two forms. A roentgen study of displacements and deformities of the colon is also of value in differential diagnosis between various forms of tumor in the left side of the abdomen.

BREITLÄNDER. Central osteoplastic sarcoma of the vertebrae in the roentgenogram. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1926, xxxiv, 523–525.

A report is given of a case occurring in a boy aged fourteen who had fallen from a bicycle. He developed neuralgic pains in the lower extremities, which became acute. Introduction of lipiodol yielded nothing definite. The oil settled down to the level of the first lumbar vertebra in a non-characteristic fashion. The clinical and roentgenological signs suggested an osteosarcoma of the fifth lumbar vertebra. There was an unusual density in the structure of this vertebra while the remaining vertebrae appeared entirely normal structurally. The fifth lumbar gave a uniformly heavy shadow without signs of a structure. Its density was so great that even in the frontal roentgenogram it showed up quite clearly.

A laminectomy was performed and a myelogenous spindle cell sarcoma was found which had caused a central softening of the fifth lumbar vertebra producing a large cavity filled with soft tumor mass. This was associated with a very pronounced new bone formation of the cavity wall so that the vertebra appeared in the roentgenogram as a structureless osteosclerotic segment. This sclerosis was confined to the remainder of the spongiosa since there was no periosteal new bone formation. This observation appears to be of unusual interest. It also shows that a differential diagnosis could not be established by roentgenographic means alone.

BROWN, R. MARK. Congenital deformity of trachea and esophagus: Report of case. *Radiology*, August, 1926, vii, 166.

A report is given of a case in an infant twenty-four hours old showing an inability to swallow. The roentgen examination showed the retention of water and barium mixture, the lower level of the meal being opposite the fourth dorsal vertebra. The diagnosis of complete occlusion of the esophagus was made.

The infant died the following day. Autopsy showed the barium mixture had reached the stomach, yet the pouch as shown on the roentgen film did not have an outlet. On passing a soft probe from the stomach upwards it was found that there was an opening into the trachea at the level of the fifth dorsal vertebra and that the barium had reached the stomach by passing down through the vocal cords and the upper part of the trachea through a congenitally formed passage into the lower part of the esophagus and then into the stomach.

BURGHARD, E. A high degree of displacement of the mediastinum in an infant as a result of congenital bronchiectasis in the left upper lobe. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, February, 1926, xxxiv, 308–311.

A report is given of a case occurring in a child aged two months who had been suffering since birth from difficulty in breathing. The roentgenogram of the thorax showed absence of the central shadow. The diaphragm on the left side extended downward to the tenth rib. The left side of the thorax was less opaque (contained more air) resembling pneumothorax, but there was no sign of a collapsed lung. In the heart region there was seen a structure about the size of an apple, of oval shape with thin walls sharply outlined. This structure appeared to be even more radiotransparent than the remainder of the left thorax.

On the right there was seen above the diaphragm a triangular shadow, and in the rest of the right thorax there was a more diffuse partially flaky or band-like shadow of medium intensity.

Puncture of the left pleural cavity gave very little air and the puncture fluid was of a bloody serous nature. The clinical examination disclosed a dextro-position of the heart. The child died suddenly of asphyxia and autopsy explained the puzzling findings by revealing a high degree of displacement and twisting of the mediastinum as a result of congenital cystic development in the left upper lobe (bronchiectasis) with secondary ballooning of this lobe.

CARTY, JOHN R. An unusual carcinoma of the esophagus: Case report. *Radiology*, July, 1926, vii, 63–64.

The patient was a man aged forty-five, somewhat emaciated, who complained of hoarseness and difficulty in swallowing for the preceding three weeks. There was a hard, fixed, deep-seated mass in the lower portion of the right anterior carotid triangle. The roentgen examination showed a smooth annular area of constriction at the level of the lower margin of the body of the second thoracic vertebra. The gullet above was markedly dilated and formed a pouch just proximal to the lesion. The barium was seen to pass straight to the constriction without first going to the bottom of the pouch and then spilling over. A very small irregular stream passed through the stricture. The laryngoscopic examination showed a paralysis of the right recurrent laryngeal nerve. A bit of tissue taken at the point of stricture showed squamous cell carcinoma. The patient was able by swallowing air rapidly to distend the dilated esophagus, which pushed the trachea forward and caused marked respiratory distress. By flexing the head forward he was able to release the air, and the trachea assumed its normal position.

CASATI, ANNIBALE. Senile changes in the cranium in the roentgenogram. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, February, 1926, xxxiv, 335–342.

The sutures in senile skulls usually become obliterated leaving a vein of sclerosed bone. The latter is usually recognized in the roentgenogram as a dense, linear shadow band. Occasionally certain sutures may remain open even in extreme old age; and sometimes all the sutures may remain open. The senile changes in the skull do not occur merely in old age. They are encountered occasionally at the end of the forties. The various peculiarities and pathological changes in the senile skull are easily determined in the roentgen examination and can be practically always differentiated from other conditions. In individual cases it involves usually the differentiation of circumscribed or localized atrophies and osteoporosis from erosions and infiltrations of the bone due to inflammation or tumor; or else the differentiation of circumscribed hyperostoses of the frontal bone from bone thickening due to tumors; and finally the differentiation of osteitis deformans from other forms of enlargement and thickening of the cranium.

CLAUS, GEORG. The shape of fluid surfaces in roentgen plates of diseased nasal sinuses. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, February, 1926, xxxiv, 262–264.

Collargol, 10 c.c. of a 5 per cent solution, was injected into the antrum of Highmore of a cadaver fixed in formalin-carbolic acid; and the same injection was made with 10 c.c. of a 10 per cent sodium bromide solution in the living subject. In both cases the roentgenogram taken in the mento-occipital diameter (the patient in sitting posture) showed in the injected antrum shadow formation in the dependent portions, the upper surface of which was marked by a concave line. This directed attention to the shape of the fluid surfaces on roentgenograms of diseased sinuses, and the author found that the concave form of the fluid surface occurred in acutely inflamed sinuses usually containing serous, rarely purulent, secretion. A convex boundary of the fluid surface, on the other hand, is found to occur in the more or less mucous, partly mucopurulent secretions associated with subacute or chronic inflammation. A convex boundary of the fluid surface is also to be found when a cystic polyp is present on the floor of the antrum. In such a case the test puncture usually yields a clear fluid. These fluid lines also appear in recurrently diseased antrums.

The finding of a shift in the shadow with change of position of the patient may give an indication as to whether a fluid or viscous secretion is present or if the condition is merely one of polypous thickening of the mucosa. The secretion generally follows a change of position of the patient, depending upon its density, and regardless of whether the patient is turned on the healthy or diseased side. However, if the secretion is too viscous its position will not change with that of the patient.

COLSTON, J. A. C., and SCOTT W. W. Horseshoe kidney, with especial reference to the importance of pre-operative diagnosis. *Urol.*, November, 1926, xvi, 319–334.

Horseshoe kidney is a congenital anomaly of sufficiently frequent occurrence to make it of

great importance to all doing renal surgery.

The anomalous position of the pelvis, the abnormal number and course of the vessels and the fixation of the isthmus greatly modify the operative technique. A pre-operative diagnosis can be made in a very high percentage of cases where all modern methods of diagnosis are employed.

A study of the ordinary roentgenogram, the pyelogram, and especially the stereoscopic pyelogram where proper technique has been used, will yield the most valuable information. In horseshoe kidney the roentgenogram discloses the outlines in a lower position than normal and closer to the vertebral column. The lower poles are indefinite as contrasted with the rest of the shadows, and often the outline of the isthmus itself can be seen across the vertebral column to join the two organs. In such cases a stereoscopic roentgenogram will often bring out the isthmus very clearly. In 2 of the authors' cases stereoscopic plain films alone sufficed to make the diagnosis fairly certain.

The pyelogram, however, is the most certain method of diagnosis. An otherwise unexplained shortening of one or both ureters may be noted, but the position and configuration of the pelvis is unmistakable. It will be found to lie lower and more toward the midline, and all the calyces will tend to take a downward direction instead of the normal distribution, and some of them will turn toward the vertebral column. Stereoscopic pyelograms are of the utmost importance especially when the pelvis has not been completely filled with the opaque medium. In such cases, the ureters can be seen bending forward to ascend over the isthmus, and when the pelvis has been completely filled it can be seen plainly lying in its characteristic anterior position.

Operative statistics show that the mortality percentage in horseshoe kidney is far higher than similar figures for operations on the normal kidney. It is believed that these higher figures are to some extent at least due to lack of correct pre-operative diagnosis. Four cases are reported.

COUTTS, W. E. Lateral cystograms. *Surg., Gynec. & Obst.*, September, 1926, xliii, 383–386.

Attention is directed to the great clinical importance of obtaining roentgenograms of the bladder with the patient in dorsal and lateral positions. The method is very simple. The patient is placed on his side on a table inclined at an angle of 35° to 40°. When the patient is in this position, the shadow of the bladder will appear between the trochanters. The contrast material is a 10 per cent solution of sodium bromide.

A study of the bladder from the lateral position makes it possible to learn its relation to the conventional anatomical lines. The floor of the bladder is always above a line perpendicular to the superior surface of the symphysis pubis and not below such a line, as is stated in some textbooks on anatomy. This misstatement has often misled roentgenologists in the diagnosis of intraprostatic calculi.

In the study of bladder diverticula it is necessary to inspect the anterior and posterior walls, which is not possible in the ordinary dorsal cystogram. Such diverticula can be located only by means of a lateral cystogram. Prostatic adenomas, bladder tumors and other involvements of the bladder region may be studied with profit in the lateral cystogram. Six cases are briefly cited.

D'AMATO, GIUSEPPE. Roentgen diagnosis of miliary tuberculosis of the lungs. *Radiol. med.*, December, 1926, xiii, 853–861.

The roentgen picture of miliary tuberculosis of the lungs is very characteristic and has been repeatedly verified on autopsy. It varies slightly depending on whether the form of the tuberculosis is productive or acinous-exudative, but both forms are characterized by an equal distribution of the rounded spots in both lung fields and by the fact that the individual spots are almost the same size. In the productive form both lung fields are literally strewn with small round spots, very distinctly outlined giving them a dotted appearance; they are quite uniformly distributed but are somewhat more dense in the upper part of the lung fields. They are so fine that they are seen better on the plate than on roentgenoscopy. Only a slight exposure is necessary, with a distance from the anticathode to the plate of a meter and a half and a film with a double reinforcing screen. In the acinous-exudative form, called also caseous miliary bronchopneumonia, the individual spots are somewhat larger and not so well defined, as they have more of a tendency to become confluent.

In connection with the roentgen pictures d'Amato takes up the question of whether an acute miliary tuberculosis may in occasional cases recover or at least become latent. He cites one of his cases in which the roentgenogram showed the typical signs of miliary tuberculosis and two months later when the patient had recovered clinically and showed no sign of the serious febrile disease which he had had, the roentgenogram still showed the characteristic dotted appearance of miliary tuberculosis.

He concludes that the miliary foci had become encapsulated as a result of an energetic connective tissue reaction which had led to their becoming sclerotic.

In conclusion, he describes a case in which anatomico-pathological examination showed that the spotted appearance of the lung fields was due to an accumulation of pigmented cells from heart disease. Great caution is necessary in making a diagnosis of miliary tuberculosis in a patient with heart disease.

DEHN, O. A case of pulmonary tumor with unusual roentgen finding. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, February, 1926, XXXIV, 333–334.

The massive shadow with a sharp lower boundary found in the right upper lobe in this case was considered indicative of a lobar carcinoma in an acutely cachectic individual without fever; yet there were also present multiple, delicate, irregular, and hazy areas of opacity distributed over both lungs which suggested lobular pneumonia more than they did tumor metastases. A sufficient diaphragmatic respiration was still present at the first roentgen examination. Subsequently acute respiratory symptoms developed suddenly, and roentgen examination disclosed a right sided elevation of the diaphragm with distended intestinal coils showing between the diaphragm and the liver shadows. At inspiration the right half of the diaphragm lifted and at expiration it sank; the left diaphragm acted normally. The sudden unilateral elevation of the diaphragm with paradoxic respiration was probably due to a paralysis of the phrenic nerve or possibly, a bronchostenosis.

At autopsy it was found that the tumor masses had displaced the main bronchus and surrounded the nerve trunks in the mediastinum. The tumor itself was a carcinoma that took in the whole right upper lobe. In addition both lungs contained scattered, soft, confluent metastases. The bronchi were surrounded by these masses thus explaining the intensified bronchial markings in the roentgenogram. This case also showed an apparent primary carcinoma of the esophagus and a fibromyoma of the uterus, i.e., three primary tumors.

In this case only the shadowing of the upper lobe and the hilus nodules could be regarded as typical of pulmonary tumor, while the hazy, delicate shadows over the lung fields only slightly resembled the well-known roentgen pictures of secondary pulmonary tumors.

ESAU. Growth disturbances of the tibial tuberosity. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1926, XXXIV, 507–511.

Brief descriptions are given of 2 cases in women and 3 in men in which the condition found was unilateral. Each patient had an otherwise normal osseous structure and showed no rachitic signs. Accidental injury was denied and the individuals reported that only the slightest symptoms were noted during the growing period. The rather noticeable exostosis of the tibial tuberosity in these cases was an incidental finding in the course of another examination. In addition reports are given of 3 cases in young persons who were under prolonged observation.

It is concluded that the changes in the tibial tuberosity are apparently due to a variety of causes. Early disturbances in the nuclear anlage may occasionally cause complete separation of the latter from the tibial diaphysis. The disturbances in ossification during youth are primarily due to trauma. It is doubtful whether rickets and tuberculosis play a part in the causation of developmental disturbance of the tibial tuberosity.

GALDAU, DEMETRIO. Osteopathology of the knee joint. *Radiol. med.*, October, 1926, XIII, 708–710.

A man aged sixty-eight was admitted to hospital in July, 1925 for pain in the right knee. It had begun in August, 1923 when the patient was working in water, caught cold and had pain in the left knee; after a few weeks it passed to the right knee. The patient was able to walk up to the end of November, 1924 but after that was bedridden. He was anemic and weak and there were signs of fibrous tuberculosis in the lungs. The right knee was swollen and sensitive, movements reduced, leg flexed on the thigh. Exploratory puncture gave a yellow liquid with no blood. Left knee also somewhat swollen but not painful.

The roentgenogram showed the classical signs of tuberculous arthritis: great atrophy, lack of periostitis, etc. In the lateral projection, in addition to these symptoms, a sort of spur of bone could be seen with its base implanted on the anterior surface of the upper third of the tibia and with its free upper extremity directed toward the joint. The left knee also showed the signs of tuberculous arthritis, but to a less degree, and the same spur. And on the proximal and distal margins of the patella shadows could be seen passing upward and downward following exactly the direction of the patellar ligament and the tendon of the rectus femoris muscle. These shadows were undoubtedly due to calcification of the patellar ligament and the tendon of the rectus femoris. The author does not believe there was any relation between the tuberculous arthritis

and these pathological new formations of bone, because tuberculosis is a decalcifying disease. And the fact that the new formations of bone in the two joints showed the same degree of development while the tuberculous lesions differed in degree also indicates that they were independent of each other. He thinks the calcification developed before the tuberculosis because the bone spurs also showed atrophy due to arthritis.

Mainoldi published a similar case in 1925 which he thought was an unusual form of Osgood-Schlatter's disease. Galdau thinks this interpretation is entirely wrong and that the calcifications were due to poor nutrition of the region caused by arteriosclerosis.

GEIPEL, P. On calcification of the heart muscle fiber. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, February, 1926, xxxiv, 311–316.

The usual descriptions of calcification of the heart tissue refer to changes in the connective tissue replacing muscle. This condition results in more or less extensive confluent zones of calcification in the heart. In contrast to this, there may occur calcification in the muscle fiber such as occurs as a result of uremic necrosis in cases of genuine contracted kidney.

A report is given of a case occurring in a girl aged fifteen who died of acute uremic poisoning. Roentgenological study of the heart tissue showed the extension and distribution of the calcified fibers which were thus localized and studied microscopically. The right auricle showed only a few calcified foci. The right ventricle was practically free of calcification immediately below the atrio-ventricular boundary which appeared as a diagonal ring-like zone. The upper third of the ventricle showed very few foci but the rest of the ventricular wall was more heavily seeded. The roentgenographic examination also permitted a study of the direction of the muscle bundles in the calcified areas. The left auricle showed numerous zones of calcification, especially pronounced in the septum. The left ventricle was calcified most markedly in the lower two-thirds of the anterior and posterior walls. The papillary muscle showed the greatest degree of calcification of all the structures studied.

GENTILE, NICOLA. A new feature of roentgenoscopy of the digestive tract: Spondylosplanchnic reflexes. *Radiol. med.*, November, 1926, xiii, 776–781.

After mechanical, electrical or thermic stimulation of the spinous processes of certain vertebrae the author finds that there are special changes in the roentgen picture of the viscera corresponding to these segments. The stomach or intestinal opacity decreases in size and moves upward and there is increased peristalsis and increased tonus of the smooth muscle fibers of the wall of the digestive tract. This spinal stimulus acts as a regulator rather than a stimulus of splanchnic tonus and motility, that is, it stimulates them if they are defective or lacking, and depresses them if they are excessive. As he has seen decrease and sometimes immediate cessation of gastric and intestinal colic on the spinal stimulus he thinks that an inhibitory action is exercised by the parasympathetic within the ganglia of the lateral chain of the sympathetic on the afferent sympathetic fibers. He has also sometimes seen pyrosis and gastric flatulence rapidly improve on spinal stimulus, from which he concludes that it also acts on the secretory cells of the splanchnic organs. The spondylo-visceral reflex is useful in diagnosis as well as treatment. He mentions 2 cases of duodenal ulcer in which a series of roentgenograms showed only slight evidence of ulcer but after thermic vertebral stimulus a second series showed much clearer symptoms.

HODGES, F. J. Roentgenological examination of the heart. *Radiology*, August, 1926, vii, 116–118.

Casual roentgenoscopic and roentgenographic observations of the heart are of little aid to the cardiac specialist in his work of appraising the circulatory status of a patient, and he has come to belittle the value of the roentgen ray in his field. However, roentgen rays can yield information of great accuracy and value.

It is possible by a certain technique to measure the cardiac area very accurately, and when carefully prepared normal tables are used for comparison, roentgen-ray studies will very quickly and accurately determine whether abnormal enlargement of the heart exists. This can be accomplished by both teleroentgenography and orthodiascopy; the latter being the quicker and less expensive method.

Normal cases never show great variation from predicted measurements. The advance of cardiac disease is paralleled by progressive roentgen findings. Mitral stenosis is particularly striking in its roentgenographic signs. Frequently in its early stages when the presystolic murmur and thrill have not developed, and always in its fully developed stage, mitral stenosis is characterized by a roentgen area of about normal size, an elongated and low-placed salient of the left border formed by the appendage of the enlarged left auricle and an obliteration of the upper portion of the retro-

cardiac space seen laterally due to the posterior enlargement of the left auricle.

KIMMERLE AND LAQUEUR. The value of the roentgen examination in the differentiation of the various forms of arthritis. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, February, 1926, xxxiv, 287–292.

In arthritis ulcerosa sicca there is usually present a roentgenologically demonstrable calcification of the arteries supplying the hip joint, while this picture is very rarely present in arthritis deformans. A pronounced calcification of the superior gluteal, obturator and circumflex femoris arteries may under circumstances, where visible arthritic changes are absent, be considered an early symptom of malum coxae senile.

A series of 7 illustrative cases is briefly described.

KLOIBER, HANS. Symmetrical epiphyseal disease in the hands. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1926, xxxiv, 500–506.

A description is given of a case occurring in a man aged 19½ who showed disease of the middle phalanges of both middle fingers, presumably of recent origin. The right middle finger was first involved followed fourteen days later by the left. The disease was characterized by a spindle shaped swelling of both middle phalanges. The swelling was clearly evident and measurement showed about 1.4 cm. greater diameter than the adjacent ring finger. Simple palpation showed the swelling was not in the soft tissues but in the bone. There was also a slight functional disturbance in bending and extending of the fingers but no pain was elicited. There was clear evidence of bone involvement, namely, at the epiphyses of the middle phalanges. The epiphyses were somewhat shortened and at the same time considerably widened in all directions. The epiphyseal line was broadened with irregular projections, and the articular space was distinctly narrowed. In the lateral view there was apparent a high grade destruction of the involved epiphyses, especially in the middle portions. At one point the destruction had progressed so far that the head of the basal phalanx appeared to be articulated directly upon the epiphyseal line of the middle phalanx. Not only was there involvement of the epiphyses but the metaphyses also showed a distinct thickening. The articular capsule was also involved because it disclosed a certain amount of thickening.

This disease shows a striking parallelism with the second Köhler's disease with which it has in common the great destruction of the epiphyses, the pronounced broadening of the metaphyses and the slight functional disturbance. The pathogenesis is not fully established but is probably due to trauma and endocrine disturbances.

KÖHLER, GEORG DIETRICH. Symmetrical bilateral malformation of the fingers and toes in a schizophrenic. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, February, 1926, xxxiv, 342–344.

Although a search of the literature since 1900 has disclosed no case similar to the one here described, it seems nevertheless plausible that malformations and endogenous psychoses may have a common origin in endogenous embryonic injury and interference to development. The case described occurred in a miner aged thirty-two. His mother, who is dead, is stated to have had the same symmetrical malformations of the hands. The patient presented the typical psychotic symptoms, but in view of the fact that he had suffered from a serious injury to head and spine in an accident there is a possibility that the diagnosis may have to be changed; but this is regarded as rather remote.

Of roentgenographic interest is the finding in this case that in the toes all middle phalanges were missing and the terminal phalanges were deformed. In the fingers the first and fourth middle phalanges were entirely absent, while in the second and third fingers they were present but shortened and contained very little diaphysis.

LENK, ROBERT. The roentgen diagnosis of carcinoma of the bronchus. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1926, xxxiv, 485–489.

Brief descriptions are given of 7 cases in which the observations of the finer anatomy or of the biology of the malignant tumors assisted in confirming the diagnosis or fully established it. This included the therapeutic employment of roentgen rays as well as the roentgenographic study with or without the aid of iodipin.

MEIER, ERNST RUDOLF. Diagnosis of the pathological-anatomical form of pulmonary tuberculosis in the roentgenogram. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1926, xxxiv, 456–471.

The data here presented were taken from a dissertation by the author. The criteria for the roentgenological diagnosis of the type of pulmonary tuberculosis are those outlined by Gräff and Küpferle and by Jaksch-Wartenhorst. The three main types distinguishable are the productive, exudative and the indurative-cirrhotic. The criteria as to the pathological anatomy of these three types are those pro-

posed by Aschoff and Nicol; and the clinical characters are those accepted by the Romberg school. These various criteria are briefly described.

The author sought to determine the agreement between the roentgenologic, pathologic and clinical findings in any case; and he made examinations which were checked at autopsy in 5 cases which are cited and in a series of clinically proven cases of which 6 are briefly cited.

It is concluded that the roentgenogram will definitely disclose in about 75 per cent of all cases the pathological-anatomical character of the pulmonary tuberculosis present. The distinction between predominantly productive, exudative or indurative-cirrhotic forms of the disease may be readily made. It is pointed out, however, that a large proportion of the cases are mixed in type and that these also can be recognized roentgenologically.

MEYERDING, HENRY W. The surgical aspect of bone tumors. *Radiology*, July, 1926, vii, 29–35.

Few physicians are so skilled as to assume willingly the sole responsibility of diagnosis, prognosis and treatment of new growths. The roentgenologist or the surgeon who is experienced in the interpretation of roentgenograms of osseous lesions may strike a high percentage of correct diagnoses. There are, however, certain lesions that baffle the clinician, surgeon and roentgenologist until exploration is performed and gross and microscopic findings are made available.

Unless the surgeon can make a positive diagnosis of a localized benign tumor he must depend on the roentgenogram to determine the local or general type of the growths and differentiate them if possible. When a malignant growth is found he must depend on the roentgenogram or evidence of pulmonary metastases. If metastasis is not found and operation is decided on, right angled views of the lesion give important data as to the site, size, origin, penetration or invasion of periosseous structure and as to whether the condition is benign or malignant. No operative procedure is justifiable when malignancy is suspected without the roentgenographic examination of the chest. Occasionally multiple benign tumors, multiple malignant tumors and metastasis to bone from the internal organs must be differentiated, and here again the roentgenogram plays an important part.

In the last analysis the clinical and laboratory findings, the gross and microscopic findings and the roentgenograms should all be considered, as it is through cooperative effort that the greatest value of the therapeutic agents can be secured.

The surgical aspects of osteochondroma are discussed and an illustrative case is cited in a young man aged eighteen. The tumors appeared to arise in the cortical and central areas at the ends and middle of the bones of the hands. These tumors were covered with a thin layer of bone and trabeculations due to irregular growth, and bony septa were distinctly visible in the roentgenograms.

A case of osteitis fibrosa cystica in a man aged nineteen is described from the surgical and diagnostic view points. There was a bony enlargement over the fifth metacarpal of the right hand, the roentgenogram of which suggested tumor. The growth was slowly enlarging. Roentgenograms showed cystic degeneration of the fifth metacarpal bone, middle and proximal phalanges of the fourth and fifth fingers. The contents of the cysts were removed and after thorough curettage the cyst walls were crushed in and the wounds closed without drainage. Facultative anaerobic diphtheroid bacilli were cultivated from the cyst contents.

A case of giant cell tumor is described in a woman aged twenty-two. The roentgenograms of the stiff left knee suggested the diagnosis of sarcoma. Further roentgenograms disclosed an area of destruction just above and involving the upper portion of the internal condyle. The tumor, which was irregular and hazy in outline, apparently originated at the epiphyseal line, destroyed the cortex, and invaded cancellous bone. There was no line of demarcation between the tumor and the periosseous structures. Amputation had previously been advised but at operation a soft tumor was thoroughly curetted and actual cautery applied. The wound was packed and a deep drain with 50 mg. of radium was left in for twenty-four hours. The pathologist's report upon the excised tumor tissue was "giant cell tumor." The patient recovered from the operation and has shown no signs of recurrence seven years since operation.

A case of endothelioma (Ewing's tumor) is described in a boy aged thirteen who complained of a rapidly growing tumor of the lower end of the left femur. Roentgenograms revealed sarcoma of the lower third of the left femur and in the chest there were signs of active metastases. Amputation through the upper third of the femur was performed and the pathologist reported an annular osteosarcoma 10 cm. long and 8 cm. in diameter. The patient recovered from the operation and left the hospital on the ninth day. Roentgen therapy was administered over the stump, groin, chest, back, pubis and the axillae daily. Coley's

toxin was given twice a week. The patient gained in weight and there was no indication of recurrence at the stump. Four months later he was taken ill with what was thought to be heart disease and died suddenly. In this case the roentgenogram of the left femur showed distinct osteolysis of the shaft due to invasion by the tumor and sclerosis and osteogenesis of the shaft. Formation of new bone within the invading tumor was abundant as shown by the presence of radiating spicules. The roentgenogram showed clearly the inaccuracy of the term "periosteal sarcoma" when applied to such tumors of osteogenic type.

Another case of endothelioma in a boy aged sixteen is described. In this case operation offered relief for twenty-five months during which time the patient enjoyed a comfortable existence.

MULLIGAN, P. B. Syphilis of the stomach: Report of case. *Radiology*, July, 1926, vii, 62–63.

A case is reported in a man aged twenty-eight complaining of vomiting and dull ache in the upper abdomen. The physical examination was negative except that the patient was much emaciated.

The roentgenographic examination of the stomach showed it to be very small with marked deformity of the pars media producing hour-glass formation and giving the stomach a dumbbell appearance. The constricted area was about 2 cm. long and about the thickness of a lead pencil. There was slight retention in the upper loculus at the end of six hours. The roentgen diagnosis was syphilis or malignancy, and although there was a negative history of venereal disease the patient's age and lack of cachexia would indicate syphilis if the Wassermann reaction should be positive. The reaction did turn out to be positive and salvarsan treatment caused disappearance of the symptoms and a return to good health.

MUZII, MARIO. Biliary calculus and cyst of the pancreas. *Arch. di radiol.*, July-Aug., 1926, ii, 577–583.

A young woman of eighteen was sent to the author with a diagnosis of gallstones. A roentgenogram of the liver region on a film 24 × 30 with a Potter-Bucky diaphragm in the dorsoventral direction showed two irregularly round opaque shadows both of them a few centimeters outside the spinal column, one at the level of the intervertebral disc between the 1st and 2d lumbar, the other between the 2d and 3d; they lay within an elongated shadow with clear outlines with a rounded lower pole extending from the shadow of the right psoas to the shadow of the kidney and partly superimposed on the latter. In a second roentgenogram in the ventrodorsal direction with a Potter-Bucky diaphragm also and exercising pressure on the abdominal organs the two shadows could be seen displaced outward and upward and isolated from the kidney shadow. In the dorsoventral picture they were smaller and had clearer outlines than in the ventrodorsal one, which showed they were nearer the anterior wall. These findings showed beyond doubt that they were two gallstones, but it did not explain the reason for the distance between them or the difference in their position in the two projections. The latter could only be explained by great mobility of the gall-bladder or liver and the former on the supposition that the shadows represented only the nuclei of the gallstones or that they were separated by other stones that were not visible.

But the gallstones did not explain all the clinical picture, as the history showed that recently the right subcostal pain had become epigastric, fixed and constant without any special relation to the gall-bladder region. Palpation also showed that the area of greatest pain was beneath the ensiform process of the sternum and that there was a uniform round resistance here. A roentgen picture of the gastrointestinal tract showed an indentation of the lesser curvature of the stomach, displacement of the stomach to the left and a filling defect of the antrum and pyloroduodenal region from pressure on the part of a round body outside of and posterior to the stomach. There was evidently a tumor here but its nature could not be determined from the roentgenogram.

Prof. Busi made a probable diagnosis of cyst of the pancreas from retention, due probably to a calculus in its descent having injured the mouth of the pancreatic duct in Vater's papilla. He admitted however that it might be a retroperitoneal echinococcus cyst. Operation showed a mobile cornuate gall-bladder containing several stones, two of them large ones with calcareous nuclei, the ones that showed in the roentgenogram. It also showed a retention cyst of the pancreas. The patient recovered and is in excellent health.

O'HARA, FRED S. Malposition of cecum and ascending colon: Case report. *Radiology*, August, 1926, vii, 166–167.

The patient, a woman aged forty-five submitted to a roentgen examination for an obscure abdominal condition. No pathology was discoverable roentgenographically until six hours had passed, at which time a screen examination yielded the information that the

patient carried a cecum and ascending colon "upside down." After ingestion of the dye the gall-bladder was found to be sufficiently suspicious to justify recommendation for surgery. At operation a large biliary concretion was removed and the malposition of the cecum and ascending colon was confirmed.

OTTONELLO, PIETRO. The aorta in chronic malaria. *Radiol. med.*, November, 1926, xiii, 769–776.

There has been a great deal of discussion as to whether malaria really causes changes in the heart and vessels. The author made an orthodiagraphic study of the aorta in 58 patients with malaria, 48 men and 10 women, care being taken to exclude all other diseases that might have affected the circulation. The blood pressure was also taken and all patients with abnormally high blood pressure excluded. The examinations were made not less than fifteen days after the last attack of fever. The orthodiagrams were made in the morning before breakfast with the patients standing. Age and occupation were taken into consideration in interpreting the results, as both have an effect on the aorta and on blood pressure.

The results showed that the diameter of the arch of the aorta is increased in chronic malaria, and the more serious and the older the infection, the greater the increase. In all probability this dilatation of the aorta is due to loss of elasticity of the artery from destruction of the elastic fibers of the media which is brought about by the intense and sudden change in blood pressure. During the attack of fever there is great hypertension of the aorta from peripheral vasoconstriction and when the fever subsides there is peripheral vasodilatation with marked fall of pressure in the aorta.

PAZZI, ERMANNO. Anterior luxation of the body of the sternum on the manubrium shown by roentgen examination. *Arch. di radiol.*, July-Aug., 1926, ii, 569–576.

A man of thirty-five was thrown from his automobile when a front tire burst and then the machine overturned on him. He struck on his head and there was a large lacerated, contused wound of his scalp in the left parieto-occipital region. When the machine fell on him he felt an intense pain in the chest. There was a swelling at the angle of Louis; the patient complained of painful pressure in the anterior part of the thorax which increased on inspiration and on movements of abduction, extension and elevation of the arms. The skin was intact over the swelling; there was no crepitation on palpation but a certain mobility in the lower half of the swelling. The roentgenogram showed that the body of the sternum was displaced forward on the manubrium and the two parts were completely detached from each other but that there was no fracture. This case is interesting from the fact that isolated lesions of the sternum are rare; it shows that luxation of the body of the sternum on the manubrium can be produced by indirect violence and the roentgenogram confirms what has been reported by other authors, that in this form of luxation it is the manubrium which remains in place while the body is displaced forward.

PAZZI, ERMANNO. Another case of multiple myeloma of the bones diagnosed by roentgen examination. *Radiol. med.*, November, 1926, xiii, 799–803.

A man aged forty-six with no personal or family history of any importance suddenly had intense pain in the back with radiation to the lumbar region. These attacks were repeated for some months after which he had no more acute attacks but a constant dull pain in the lumbosacral region. Various diagnoses were made such as arthritis, uricemia, rheumatism, lumbago. When he was sent to the author's genito-urinary clinic a roentgen examination of the kidney region was made as is done systematically in all cases. This showed great changes in the vertebrae, especially the 12th dorsal and the 3d lumbar. Another examination of the ureteral and bladder region showed changes in the sacrum, pubis, ilium and heads of the femurs. The bones, especially the spongy parts, were spotted, with decalcified transparent areas and others darker from condensation of bone. These zones were more or less rounded but with irregular outlines and of various size. The vertebrae were flattened. The same changes were found in the bones of the head and arms and in the ribs. Bence-Jones bodies were found in the urine. This case of multiple myeloma of the bones could not have been diagnosed in any other way than by roentgen examination.

PESCATORI, GUIDO. Roentgen diagnosis of adhesions of the right colon. *Radiol. med.*, October, 1926, xiii, 685–708.

Pescatori reviews the different types of adhesion of the right colon, their pathogenesis and the difficulty of making a clinical diagnosis. He then emphasizes the importance of roentgen examination which may sometimes not only reveal such adhesions but also unsuspected inflammatory conditions, latent or active, in the viscera adjacent to the colon. It is not unusual, however, for even a roentgen examination to give an indefinite picture.

The changes in the colon which may be detected on roentgen examination include fixation in a normal or abnormal position, the existence of stable kinks or curvatures, the presence of stenotic segments and of dilatation and stasis in front of the stenosis, adhesion of single loops of the colon to each other or to adjacent viscera, and the presence of an accumulation of gas in the hepatic flexure.

Among the stable kinks he mentions a gibbosity of the ascending colon described by Busi and gives the history of a case which showed this alteration and in which it may have been due either to adhesions or to a persistent spasm of the cecocolic region and the pressure exercised by the sigmoid on the cecum. The operative findings in this case would have been interesting but on account of the uncertainty of the findings operation was not advised. The author saw the patient after eight months of treatment and the disturbances had been very much decreased by curing the constipation.

Attention is called to the fact that persistent spasm of the cecocolic portion may lead the physician to make a mistaken diagnosis of adhesions. In this connection the author describes a case in which an appendicitis had caused prolonged spasm of this portion, while in another case stasis of the cecum was caused by pericecal adhesions. A gas bubble above and to the median side of the right flexure of the colon may be of considerable value in the diagnosis of adhesions of the colon at this site. In this connection he describes 2 cases of calculous cholecystitis in the first of which he made a probable diagnosis of pericolic adhesions from the presence of such a gas bubble and this diagnosis was confirmed by operation. He also describes a case of ulceration with thickening of the walls of the last loop of the ileum where the roentgen picture looked like that of adhesions between the ileum and the cecum. It is really sometimes very difficult to diagnose adhesions, but many mistakes are due to lack of sufficiently careful observation.

Phemister, D. B. A study of the ossification in bone sarcoma. *Radiology*, July, 1926, vii, 17–23.

For purposes of roentgenologic study of their ossification, bone sarcomas may be divided into four main groups: (1) those containing tumor bone only; (2) those containing tumorous and non-tumorous bone; (3) those containing non-tumorous bone only; (4) those containing no new bone.

(1) *Bone sarcomas containing tumor bone only* are seen mainly in adults, and are either osteogenic or chondrosarcomas. Osteogenic sarcomas usually arise centrally, erode the cancellous bone and cortex and make a lesion which fills much of the space in the end of the shaft and also appears soon as an external swelling. The degree of ossification varies but is often marked. The new bone forming in the portion of the tumor within the old bone has an irregular spongy arrangement. The external swelling is usually dense and spongy in its deeper portions, but there may be radiating spicules about the periphery. There is no layer of non-tumorous periosteal new bone tapering off on the shaft about the limits of the tumor. Examples are cited from two cases. Radiotherapy exerts little influence on markedly ossifying sarcomas such as occurred in these cases; both had received intensive treatment without noticeable effect.

Primary chondrosarcomas usually show some tendency to calcification and ossification. They may begin peripherally or centrally, a moderate amount of calcified cartilage and bone may appear and these may form islands separate from the old bone. In roentgenograms, isolated calcareous shadows within the confines of a tumor, either primary or metastatic, are almost pathognomonic of chondrosarcoma.

(2) *Bone tumors containing both tumorous and non-tumorous bone* are seen mainly in adolescents. At this age an osteogenic sarcoma with radiating new tumorous bone may stimulate periosteum to form a varying amount of non-tumorous bone on the shaft beyond and along the uninvolved cortex at the level of the tumor. An example of this type of tumor occurring in a boy aged seventeen is cited.

(3) *Bone sarcomas containing non-tumorous bone only* occur also largely in adolescents, and are central destructive lesions which stimulate the periosteum of the vicinity to new bone formation. The non-tumorous new bone has the same characteristic as that described in Group 2. Occasionally there may be irregular ossification about the periphery. Ewing's endothelioma is particularly apt to produce this picture. Radiating, non-tumorous bone, usually limited in amount, may form within the tumor as an outgrowth from the old cortex. An illustrative case is briefly cited.

Telangiectatic sarcoma in adolescents or young adults invade both the cancellous bone and medullary regions and extend through the cortex making a peripheral swelling. They break down rapidly leaving a cavity with only a small amount of living tumor about the periphery. A small amount of non-tumorous bone may be formed by the periosteum about their limits, but it casts little shadow so that roentgenographically one sees mainly bone destruction and the shadow of the soft parts of the tumor.

(4) *Bone sarcomas containing neither tumorous or non-tumorous bone*, or at most only traces of ossification are common in adults. They arise nearly always centrally although there is occasionally a primary periosteal fibrosarcoma of this type. When small and confined almost entirely to the bone they may be confused roentgenologically with central giant cell tumor, but their outline is much more irregular than that of the latter. They enlarge rapidly and invade the soft parts surrounding the bone. New bone does not form from the periosteum about their periphery. They usually run a rapid course and produce metastases which also are free from ossification. An example is cited of a large central sarcoma of the upper end of the ulna amputated eight months after onset in a man aged twenty-seven.

Possati, Alberto. The roentgen picture of horseshoe kidney. Two new cases, diagnosed by roentgen examination. *Radiol. med.*, October, 1926, xiii, 726–735.

Possati has previously published an article in which he described 3 cases of horseshoe kidney; in the present article he reports 2 more illustrated by roentgenograms. He emphasizes the importance of pyelography and stereopyelography in this affection. In one of the cases published in this article and in one of those in the previous article in addition to the anomaly of the kidney there was also a skeletal malformation. In the former there was a supernumerary lumbar costiform process, while in this one there were two supernumerary lumbar processes which articulated with the transverse processes of the first lumbar vertebra. Objective examination of the patients, both before and after the roentgen examination did not show any resistance in front of the spinal column on palpation which might have aroused the suspicion of a fibrous bridge connecting the lower extremities of the two kidneys.

Pribram, B. O., Grunenberg, K., and Strauss, O. Cholecystography and its diagnostic significance. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, February, 1926, xxxiv, 235–244.

The roentgenological demonstration of the gall-bladder with the aid of contrast dyestuff permits the diagnosis of calcareous gall-bladders, stenosis of the cystic duct, ptotic gall-bladders, etc., with relatively great certainty. On the other hand, when yielding a normal gall-bladder picture it constitutes a reliable means for excluding disease of the gall-bladder. For the diagnosis of pericystic adhesions and altered position of the gall-bladder, it is desirable to obtain additional evidence by means of a collateral duodenal filling and also to make a study by serial roentgenograms of the ability of the bladder to empty and to contract.

The examination should be made primarily upon the gall-bladder which has been emptied. In order to avoid interfering reactions, a prophylactic injection of atropin would appear to be highly desirable. The infusion of dye is best carried out with the aid of an infusion cylinder and should be conducted very slowly. Tetraiodophenolphthalein is preferable to tetrabromphenolphthalein for injection. The quantity sufficient for ordinary purposes is 3 gm., at a maximum 5 gm. The intravenous method has been found to give more reliable results than the oral. The authors recommend the method very highly and regard it as entirely without danger provided the necessary precautions are followed.

Reich, Leo. The roentgenogram and the orthodiagraphic measurements of the aorta in the second oblique diameter. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1926, xxxiv, 322–333; 472–481.

An analysis of the anatomical relations shows that the orthodiagraphic measurement of the diameter of the ascending aorta from the first oblique position by the classical method of Holzknecht is incapable of giving correct values. The procedure recommended by Kreuzfuchs in which a modification of the first oblique diameter technique is employed is also objectionable. Anatomical study reveals no contradiction to the accuracy of the values obtained by the latter method. However, the degree of variation in the extent of the isthmus and the indirectness of this method do not permit reliable conclusions to be made as to the condition of the aorta.

The roentgenogram taken in the left forward oblique position (second oblique diameter) is described by the author, and a spot is indicated from which the ascending aorta may be measured orthodiagraphically. This method is recommended because it is regarded as the most reliable one for study of the ascending aorta. It was observed that the inner contour of the aortic arch failed to show visible pulsations in this position.

Measurements were made in 100 cases of the ascending aorta in both the first and second oblique diameters. In 40 normal hearts there was 77.5 per cent agreement between the two types of measurement, and among 60 pathological hearts there was agreement of the two measurements in 66 per cent. It is therefore assumed that in roughly 70 per cent of the cases correct values for the diameter of the ascending aorta are given by either method. It

was found that the diameter in the first oblique position was greater than that in the second in cases where the normal or pathological aorta was associated with a superior vena cava that was distended (as in cases of mitral disease). The diameter in the first oblique position was found to be smaller than in the second when the ascending aorta was considerably dilated, although no stasis in the vena cava was present. The differences observed are regarded as due to errors associated with measurement in the first oblique position, whereas the second oblique diameter is free from these sources of error.

A comparison of the diameter of the ascending aorta determined by the author's method with that determined by the Kreuzfuchs technique indicates that the latter alone is not capable of giving a reliable measure of either the ascending or descending aorta. It is only rarely possible to measure the diameter of the descending aorta in the second oblique diameter, but where it is possible it may yield interesting results.

A new method is described for determining the diameter of the aorta from a geometric reconstruction of the direction of the beam and the angle of rotation. Assuming that the cross section of the ascending aorta is a circle, this circle may be constructed geometrically from three tangents, and the correctness of this construction is checked by a fourth tangent. This particular method is not easily applicable in general practice, but it yields a check on the correctness of the orthodiagraphic measurement.

Reich, Leo. Diaphragmatic hernia of the right lobe of the liver., *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1926, xxxiv, 481–484.

Reports are given of 2 cases. In the first which occurred in a man aged thirty-two a pneumoperitoneum caused a pneumothorax and thus helped to disclose the nature of the condition. The herniated abdominal structure within the thorax was found by a method of exclusion to be the liver. The introduction of contrast material per os or per rectum caused no change in the appearance of the herniated structure. The latter also exhibited considerable mobility with change in position of the patient. The diagnosis in this case was spurious traumatic diaphragmatic hernia of the right lobe of the liver.

The second case occurred in a man aged fifty-nine who gave a picture very similar to that seen in the first case. Here also the pneumoperitoneum assisted in the differential diagnosis by failing to give a simultaneous pneumothorax. The condition was diagnosed as paralysis of the phrenic nerve due to lead poisoning.

Reiser, Egon. Theoretical and personal observations on myelography. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1926, xxxiv, 443–455.

The suboccipital injection of 2 c.c. lipiodol has never resulted in any injury to a patient. It is possible and very desirable to observe the settling of the contrast material roentgenoscopically. It may be expected that such observation in conjunction with a suitable roentgenographic technique (patient in oblique recumbence, i.e., partly upright) will lead to early diagnosis of small tumors. The suspected region should be roentgenographed before the introduction of the lipiodol so as to obtain a record of all changes in the spinal column without interference of foreign material. Such roentgenograms are of importance in the differential diagnosis. These and all other pictures should be taken both sagittally and laterally (or obliquely).

When the contrast material has been introduced and its progress to the narrowed region traced, roentgenograms should be taken with the patient in the recumbent and in the upright or semi-upright positions. The roentgenograms in the recumbent position frequently show the course of the spinal cord above the point of compression, because the medulla frequently appears as a clear space within the shadow of the contrast material or within two marginal strips. The upright or semi-upright position produces an intimate contact of the lipiodol with the structure which is blocking the spinal canal. The lower portion of the filling shadow in these roentgenograms indicates the shape of the compressing agent, which may be lost in roentgenograms taken in the recumbent position.

Primary intradural tumors may be recognized as spherical, convexly outlined, clear areas below or within the filling material. Connective tissue atrophy may also produce clear areas, but these usually have a straighter or a concave boundary. This picture may also be exhibited by extradural tumors. Not infrequently, the tumor may be covered over with adhesions, and if the latter should happen to coat the tumor closely like a skin then the picture of the conditions in the zone of compression will not be appreciably disturbed. Should, however, the adhesions be extensive, they may keep the contrast material from reaching the actual point of compression, and it will then be impossible to form any opinion as to the shape of the pathological process producing the compression. Within the clear

areas, there may appear disturbing shadows produced by skeletal structures which render difficult the morphological interpretation of the myelogram. Such interferences are mainly due to the spinous processes.

A series of 5 cases is described and pictured.

RICHTER, HELMUTH. Simplified method for stereoroentgenography of the mastoid process, the middle and inner ear. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, February, 1926, xxxiv, 293–296.

Two methods are employed: (1) the Stenvers technique, and (2) a tangential technique based on that of Staunig. In the latter the occiput lies on the cassette, the face is turned 20° away from the side to be roentgenographed and the central ray is made exactly tangential to the lower margin of the zygomatic arch, at the lower margin of the processus articularis manbidulae and made to pass through the center of the mastoid process, exactly through the region of the middle ear. Both methods are best carried out with the patient in the sitting position. By means of a system of sights, the adjustments can be made with ease; and the stereograms are produced by rotating the tube 20° to the right and 20° to the left.

The methods are so devised as to permit the taking of the two roentgenograms on one film 13 × 18 cm. The methods are recommended because they are not difficult and do not consume too much time.

ROTHBART, LADISLAUS. Kidney abscess in the roentgenogram. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, February, 1926, xxxiv, 350–351.

A report is given of a case occurring in a man aged thirty-two in whom the kidney abscesses were directly visible in the roentgenogram. Early roentgen examinations made once by another roentgenologist and once by the author were negative. There was moderate sensitiveness in the left lumbar region and a later roentgenogram disclosed two clearly circumscribed shadows at the cranial pole of the kidney. The left kidney was slightly enlarged. Operation was refused at this time, and four days later another roentgenogram showed the upper two-thirds of the kidney diffusely clouded. The temperature of the patient increased and his general condition demanded an operation. Examination of the removed kidney confirmed the finding but disclosed also a number of small abscesses. The patient made an uneventful recovery.

RUGGLES, HOWARD E., and BRYAN, LLOYD. Bone malignancy from the roentgenological aspect. *Radiology*, July, 1926, vii, 24–28.

At the present time one can recognize with fair accuracy typical examples of the following primary tumors: (1) giant cell tumor; (2) osteogenic sarcoma; (3) undifferentiated osteogenic sarcoma; (4) endothelioma; (5) myeloma. There are many borderline and atypical lesions which are not clean cut either roentgenologically or pathologically.

Giant cell tumors have a characteristic appearance. They present rarefied areas, showing thin-walled trabeculae somewhat suggestive of soap bubbles. There is asymmetrical expansion of the affected region with a tendency to follow into processes and condyles. They extend to the joint cartilage but do not invade it. There is no periosteal reaction unless fracture is present. They are most common in the age period twenty to forty years. Malignant changes are possible but extremely rare.

Osteogenic sarcoma is practically always seen in the distal third when it occurs in long bone. A location in the middle third of the shaft is strong evidence against an osteogenic tumor. These growths appear before thirty, tend to recur locally and produce pain, fever and metastases. Roentgenologically the subperiosteal is the most common form. It begins as an irregular erosion of the cortex with very early elevation of the periosteum and new bone formation at the margin of growth. This is its most important characteristic. In rapidly growing tumors this limiting reaction of the periosteum may be absent. As the process develops the marginal reaction increases, erosion of the cortex becomes more prominent, the medulla is involved and a variable amount of calcification appears in the soft tissue tumor. The medullary form gives an irregular area of rarefaction in the cancellous bone showing no well organized trabeculation within it. Rupture of the cortex and extension into the soft tissues occur easily. Lesions of the flat bones are usually of the medullary type with bone destruction as their predominant feature. In some cases there is an amount of trabeculation which gives them a strong resemblance to giant cell tumors.

Undifferentiated sarcoma is a purely destructive process which takes everything before it. The lesions have fairly sharp irregular margins and there is no trace of bone reaction.

Endothelioma appears in two forms probably depending upon whether it develops from the blood vessels of bone substance or of marrow. In the first form they are similar to osteogenic sarcoma and may be diagnosed as such. They are situated somewhat farther from the ends of the long bones and there is more localized destruction of the cortex. There is usually more periosteal new bone formation which may occur in layers partially or completely surrounding

the tumor. The second form produces a mottled or coarsely trabecular structure in the affected bone, somewhat suggestive of osteitis deformans in some cases and of myeloma in others. Usually a considerable portion of the shaft is involved. In the flat bones it may resemble giant cell tumor. The second type may be separated from myeloma by the fact that it is a single lesion and by the absence of albumosuria. Endothelioma does not expand the bone as strikingly as giant cell tumor and the trabeculation is heavier and coarser.

Myeloma appears in multiple foci, always in cancellous bone and is most common in ribs, sternum, vertebrae, skull, femur and pelvis. The tumors are small nodules or large bulky growths, chiefly in males of the fourth and fifth decades. They produce considerable deformity in bone outline due to irregular growth and they usually show coarse trabeculation. Individual lesions in flat bones may resemble giant cell tumors or endotheliomas, but the presence of other lesions will exclude them.

Out of a total of 650 cases of bone sarcoma in the Registry there are 26 per cent of giant cell tumor, 40 per cent osteogenic sarcoma, 10 per cent endothelioma and 2 per cent myeloma. The authors' material consists of 72 cases of bone malignancy from a total of 220,000 cases, or one case for every 3000 examinations. These are tabulated according to age and localization of the tumor.

Swanberg, Harold, and Montgomery, E. B. Solitary diverticulum of the jejunum. *Radiology*, August, 1926, vii, 144–148.

A report is given of a case occurring in a woman aged fifty-five in whom the solitary diverticulum of the jejunum was diagnosed roentgenologically but not confirmed by operation. The patient had been suffering from periodic vomiting, the cause of which was obscure. The barium meal readily entered the stomach which began to empty at once giving an appearance similar to that in which a large gastroenterostomy has been done. There was a normal gastric contour except on the greater curvature, in its middle part, where there appeared to be a distinct large bulging as if a diverticulum were present. The sacculation was nearly oval, measuring about 6 cm. in its greatest diameter. At six hours the head of the meal was in the transverse colon and a small gastric residue was seen in addition to the above mentioned sacculation which still contained barium. At twenty-four and forty-eight hours barium was scattered throughout the colon but the same sacculation still contained barium. Views from different angles showed that the sacculation was not connected with the stomach but posterior to it presumably of the jejunum.

The roentgenologic findings and the clinical history of acute intestinal obstruction point clearly to a diagnosis of large diverticulum of the beginning portion of the jejunum.

Tartagli, Dino. A case of idiopathic dilatation of the esophagus. *Radiol. med.*, October, 1926, xiii, 711–719.

A case is described in a woman aged sixty in which both the clinical and roentgen signs were typically those of idiopathic dilatation of the esophagus. All the signs of disturbed motility of the esophagus were evident. From the signs in his case the author doubts the reliability of Holzknecht's test and in studying the pathogenetic mechanism of the condition he arrives at a hypothesis similar to Hurst's of achalasia, or defective relaxation, of the cardia. A nervous incoordination, probably due to lesion of vagus filaments, causes a defective relaxation of the cardia. The part of the esophagus above it suffers motor incoordination as a result, and reacts with hyperperistalsis or possibly antiperistalsis. The increased peristaltic contractions cause changes in the delicate wall of the esophagus gradually leading to hypertrophy, but if the primary disturbance persists it will finally exhaust the defensive power of the esophagus whose walls will gradually dilate, with consequent decrease and finally total disappearance of the peristaltic wave. It is in this stage of complete idiopathic dilatation that the patients generally present themselves for treatment.

Tonelli, Giovanni. Atypical cases of echinococcus of the lungs. *Radiol. med.*, December, 1926, xiii, 874–888.

Tonelli presents the roentgenograms and case histories of 2 cases of atypical echinococcus of the lung. There was no eosinophilia in either of the cases and in one of them the intradermal reaction was negative. In this case there were no percussion signs to indicate a cyst and up to the evening before the operation the patient was thought to have tuberculosis, but operation showed a large cyst, probably interlobar. In the second case the cyst ruptured spontaneously in the course of a clinical examination and this was followed by a miliary tuberculosis from which the patient died. In both cases a roentgen examination helped in making a probable diagnosis. But the author thinks that roentgen examination is not absolutely reliable in this respect. He reports cases of sacculated pleurisy and abscess of the lung in which differential diagnosis was impossible and gives the history of a case still under treatment in which it has

been impossible to decide between tuberculosis and echinococcus cyst although the patient has been under observation for some months. The last roentgen examination showed advanced calcification of the first costal cartilage which is deformed. The ribs on the right are more horizontal than those on the left and the intercostal spaces narrowed. The upper two-thirds of the right lung field is occupied by a dense opacity in which there are little round spots of different sizes containing air. In the upper part of the right hilus there is a mulberry-shaped spot of calcified glands. The mobility of the right half of the thorax is decreased; the costo-diaphragmatic sinus on that side is partly obliterated. The trachea is deviated to the right, particularly the lower part of it. Since this examination the patient has been given pneumothorax treatment and intravenous injections of yatren and seems to be improving under it.

TURNER, GEORGE. Actinomycosis of the lungs. *Radiology*, July, 1926, vii, 39–43.

Any continued chest infection in which there is no evidence of tuberculosis should be considered as a possible ray fungus infection and study should be made of the sputum and the roentgenograms with this in mind.

From a roentgenographic point of view there are two types of actinomycosis of the lungs. In one type the infection involves the hilus and extends along the bronchi producing peribronchial infiltration with extensive fibrosis. The extension is more likely to travel downward than upward. The granulomatous masses are miliary in size and very dense along the inner lining of the bronchi. When these granulomas suppurate, expectoration is profuse, usually blood-stained and containing actinomycetes.

The other type of actinomycosis involves the lung tissue proper and presents a picture of abscess. Pleural involvement soon occurs with possible empyema and fistulous tracts through the skin. The infection may begin as a bronchial type and continue as a severe and stubborn bronchitis when a well-defined circumscribed area will appear in the lung tissue. A tendency of the disease is to jump across what appears to be normal tissue. The lesion is more progressive than the usual lung abscess found in tuberculosis or after pneumonia. By making roentgenograms at intervals of about two weeks and comparing them the condition can be differentiated from other forms of lung abscess. Syphilis, malignancy and tuberculosis of the lung should be easily differentiated from actinomycosis. It should be remembered, however, that while actinomycosis presents characteristics peculiar to its own form of lesion, there is nothing sufficiently distinctive roentgenologically to permit a diagnosis from roentgenographic examination alone. A correct diagnosis depends on the close cooperation between roentgenologist, clinical microscopist and clinician.

A report is given of a case occurring in a man aged thirty-eight.

ROENTGEN AND RADIUM THERAPY

ALBERTI, W. On the irradiation technique of carcinomas of the eyelid. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, February, 1926, xxxiv, 349–350.

The eyeball shields proposed by Müller cannot be used in cases where the eyelids have undergone extensive pathologic change. In such cases the author proposes the preparation of shields constructed for the individual case from lead foil covered over with gutta percha.

CHARLTON, C. F. The biological effect of radium. *Radiology*, August, 1926, vii, 137–139.

Microscopic sections taken at intervals from irradiated growths in process of resolution show a definite sequence of changes for both radium and roentgen rays. These consist of, first, a latent period during which no changes are observed in the tumor cells. At this time, however, an inflammatory reaction is taking place in the stroma. There is hyperemia and exudation of polymorphonuclear cells and lymphocytes. Following this period alterations appear in the malignant cells: they swell to giant proportions. The third phase is represented by keratinization and finally deposition of fibrous tissue. The lymphocytes, fibroblasts and dilated capillaries dominate in this late picture.

The second phase of the reaction wherein there appears a swelling of the malignant cells has given rise to the thought that irradiation generates new electrolytes in the malignant cell which in turn alter osmotic relationships and draw in water. The author has sought to determine this experimentally by the irradiation of egg white. This material received an exposure of 100 to 5000 mg-hr. Each specimen was put in an egg membrane dialyzer, immersed in normal saline and the swelling measured against controls. Under 2000 mg-hr. there is no difference between the irradiated and control specimens of egg white, and it is concluded that there is no reason to believe that a change in the osmotic properties is accomplished by irradiation applied therapeutically. Perhaps the therapeutic value of these radiations lies

in the reaction they bring, or in other words, the mesoblastic response.

Curtis, Winterton C., and Hickman, Jane. The effects of *x*-rays upon regeneration in planarians. *Science*, May 14, 1926, lxiii, 505–506.

An analysis was made of the relation between the formative cells and regeneration of *P. agilis*. A few experiments conducted on *P. velata* gave similar results. Since in the higher animals germ cells and cells of embryonic type are highly susceptible to roentgen rays, it was thought that the formative cells of planarians which are embryonic and germinal might react in a similar manner. Such appears to be the case.

One series of experiments upon *P. velata* shows that irradiation destroys the power of regeneration in this species also. It is believed that the roentgen-ray treatment may be employed as a method of technique in cases where the histology of regeneration is obscure. Perhaps it may also be utilized for the early detection of germ cells in the development of various organisms.

Debiasi, E. Factors which affect prognosis in the radiotherapy of cancer of the uterus. *Radiol. med.*, October, 1926, xiii, 719–726.

The material of Döderlein's clinic includes about 2700 cases of carcinoma treated since 1913 exclusively by radium or roentgen rays. The author considers only the cancers of the cervix in his discussion. The chances for recovery of these patients depend not only on the extent of the tumor but also on various other factors, among them the morphological character of the tumor. Carcinomas with immature cells present a more favorable prognosis than ones with highly differentiated cells with a tendency to cornification. The condition of the organism as a whole also helps to determine the outcome, as shown by the great difference in results obtained in women whose age, general condition and economic status varied greatly. The largest number of cures was between the ages of forty-five and fifty, the lowest between fifty-five and sixty. Women of means of course present a better prognosis than poor ones, not only because they can have better food and take better care of themselves but because they consult the physician on the first signs of disease while the poor ones defer it as long as possible. The condition of the blood is important. According to Wintz a leucocyte count of less than 2500 with lymphopenia and a hemoglobin of less than 40–35 per cent should be regarded as absolute contraindications to radiotherapy. With regard to the effect of other diseases on the prognosis, it seems that diseases of metabolism and chronic infections do not have any special effect. Active tuberculosis of the lungs contraindicates the treatment. Goiter has no particular effect on the prognosis. But there seems to be a relation between the function of the hypophysis and cancer of the genitals. Hofbauer noticed that irradiation of the hypophysis brought about involution of a carcinoma of the vulva. Irradiation of the hypohysis has been practiced systematically in the clinic of Monaco since 1923. The patients given this treatment have shown an extraordinary increase of weight, much greater than before this method was adopted. Radiotherapy is dangerous in patients with virulent streptococcus infections; according to Döderlein a virulence test should be made before any diagnostic or therapeutic use of rays. Another factor which affects prognosis is the weight of the patient. Patients who show a progressive decrease of weight never recover.

Desjardins, Arthur U. Radiotherapy for lymphoblastoma. *Radiology*, August, 1926, vii, 121–130.

Radiotherapy does not prolong the life of patients suffering from lymphoblastoma. This does not mean that the treatment does not exert any influence on the disease. It is well known that its clinical manifestations can generally be controlled and that many patients can be restored to a relatively normal state of health for long periods. Massive enlargement of the cervical, axillary and inguinal glands and voluminous mediastinal and retroperitoneal adenopathy can be obliterated. Distressing secondary phenomena such as dyspnea, venous engorgement, toxic pruritus and pleural effusion can often be relieved. Moreover, the reaction of lymphoblastomatous deposits to irradiation is so characteristic as to constitute a valuable therapeutic test when biopsy is not possible.

The above conclusions are drawn from a review of a series of cases receiving more or less systematic treatment with radium or roentgen rays. These include all the patients registered at the Mayo Clinic during the four-year period 1920 to 1923 inclusive. The diagnosis was definitely established by biopsy. There were 57 cases of Hodgkin's disease and 126 of lymphosarcoma. The various statistical aspects of this series of cases are presented in a number of tables.

Ferreri, Giorgio. Radium surgery of malignant tumors of the ethmoid and superior maxillary. *Radiol. med.*, November, 1926, xiii, 804–825.

Ferreri advocates combined radium and surgical treatment of malignant tumors of the

superior maxillary. He describes 5 cases in which he partially resected the bones which were invaded and removed the tumor masses, so that the radiant energy could exercise as deep an action as possible on the normal tissues and bring about an intense defense reaction. Two of the cases were epithelioma, one a malignant papilloma, one a cylindroma and one an endothelioma. In one of the patients there was a local recurrence fourteen months later while the others are all entirely cured. The surgical operations were almost two years ago. He thinks it is very important to make a histological examination of the tumor in order to be able to give a rational and accurate radium treatment, as the dose varies depending on the nature and malignancy of the tumor. He thinks that moderate amounts of radium should be used (15 to 25 mg. radium element) which should be left in contact with the tumor for four or five days so that a dosage of 13 to 20 mc. is given. Care should be taken not to exceed 20 to 25 mc. if all danger of necrosis or sequestration of the neighboring parts is to be avoided. He did not see any local or general disturbance in any of his patients.

Herendeen, Ralph E. Diagnosis and results in the radiation treatment of some medullary bone tumors. *Radiology*, August, 1926, vii, 140–143.

In attempting to diagnose bone tumors it is necessary to exclude infection, changes resulting from chronic constitutional disease, atrophy from disuse or pressure as possible causes. The location of the tumor is one of the most important points in the diagnosis of giant cell tumors. Of the conditions least suspected when the diagnosis of giant cell tumor is being considered, and probably more frequent than any other are the osteogenic chondrosarcomas; the next in frequency are the myelomas. Ewing's tumor though medullary in origin seldom has many of the characteristic features of a giant cell tumor. The conditions which simulate it more closely than others are carcinomatous metastases and especially metastases from hypernephroma.

Giant cell tumors, chrondrosarcomas and Ewing's tumor all respond differently and in characteristic ways to radiation therapy. There is probably no bone tumor that shows a more immediate or active response to irradiation than Ewing's tumor. Giant cell tumors following a fairly heavy irradiation show a reaction which reaches its height in three to six weeks. The reaction is characterized by redness, swelling and tenderness—sometimes to such a degree that one may suspect the growth to have taken on marked activity. As time goes on the reaction subsides and the tumor becomes firm to the touch. Roentgenograms made later often demonstrate definitely that the tumor is becoming well calcified.

In the case of chondrosarcomas this reaction to irradiation is uncommon. The tumor responds slowly in comparison to other malignant bone tumors. It may be many weeks before any effect of the treatment is visible along with diminution in the size of the tumor. The pain also slowly disappears and at this time a roentgenogram may demonstrate some attempt at ossification or at bone repair.

Although the author does not recommend pre-operative irradiation in malignant bone tumors as a routine procedure, instances are known where the long-continued use of radiation prior to amputation seemed to be a factor in preventing metastasis to the lungs. In these cases the radiation therapy was followed by the production of much fibrous tissue, complete or partial encapsulation of the tumor by fibrous tissue or bony material, and necrosis or degeneration of large areas of the tumor. Amputation should be limited to those cases in the elderly or middle aged where the location and extent of the tumor is such that regeneration of bone or rather production following curettage or radiation, will not be sufficient in quantity to restore the limb to usefulness.

It is the belief now at the Memorial Hospital, New York City, as a result of the observation of a large number of giant cell tumors of bone treated by radiation alone during the past five or six years that in most instances the results warrant a trial of radiation therapy before resorting to curettage or amputation.

Heymann, P. Treatment of malarial spleens by roentgen therapy. *J. de radiol. et d'électrol.*, November, 1926, x, 481–492.

Heymann describes 10 cases of malarial spleens treated by roentgen therapy. He thinks the differences in the reports in the literature are due to the fact that no distinction has been made between acute and chronic cases. In his acute cases in which the spleen was not very much hypertrophied and the malarial infection relatively recent the spleen returned to normal size. In the chronic cases with enormous hard spleen in individuals who had been infected a long time there was slight decrease in the size of the spleen but never complete return to normal. This is because of the difference in the nature of the enlargement in the two classes of cases. In the acute cases there is simple congestion of the Malpighian follicles; in the chronic cases there is not only congestion of lymphoid tissue but hyperplasia of connective tissue. While roentgen rays have a marked action on

lymphoid tissue they have practically no power for destroying connective tissue. He believes that in view of the long duration of the treatment and the difficulties in its application roentgen treatment is not to be recommended in malaria because the acute cases recover spontaneously or under quinin and arsenic treatment while the chronic cases require surgery.

Hirsch, I. Seth. The *x*-ray treatment of hypofunction of the ovary, with special reference to the regulation of menstrual function. *Radiology*, August, 1926, vii, 93–103.

The menstrual deficiencies amenable to roentgen treatment may be classified in three different ways: (*a*) as to cause, (1) essential menstrual deficiency due to changes in the generative organs; (2) symptomatic, associated with systemic diseases as chlorosis, tuberculosis, etc.; (*b*) as to type, (1) complete cessation—amenorrhea; (2) scanty amount at normal intervals—oligomenorrhea; (3) normal amount at prolonged intervals—opsomenorrhea; (4) scanty amount at prolonged intervals—oligo-opsomenorrhea; (*c*) as to the time of its inception, (1) at puberty; (2) after a period of more or less normal menstruation. Any one of the types of menstrual deficiency above described and also associated sterility may be helped by radiation therapy. In all the types of cases suitable for treatment, there must be direct and indirect evidence that ovarian tissue exists in sufficient amount to respond to the action of the radiation.

The treatment consists in the administration of a small dose of radiation to each ovary. The dose necessary for the desired effect is 15 per cent of the castration dose delivered to each ovary through two portals. It is necessary to treat both sides because of the alternate ovulation. The four portals which take in all the pelvic structure may be irradiated at one sitting or a portal at a time with intervals of a day or two. The series should not be repeated until after a lapse of several months, but meanwhile a small dose of radiation may be applied to the thyroid or the hypophysis if the status of the individual demands it. A slight variation from the 15 per cent dose may be necessary, depending on the age, thickness of the abdominal wall and duration of ovarian hypofunction. There should be no roentgen sickness and no change in the skin of the areas treated. If a roentgen treatment shows no results irradiation must not be continued.

The treatment is contraindicated in symptomatic amenorrhea associated with general systemic diseases as syphilis, tuberculosis, nephritis, pernicious anemia; also when secondary to adnexal disease, tumor or cystic disease of the ovary. Amenorrhea in advanced age or of very long duration or that resulting from curettages after numerous abortions does not respond to this treatment. In dystrophy-adiposogenitalis, the involvement of other endocrines may necessitate other treatment.

The results obtained in 36 cases are discussed and tabulated. In 22 of the cases menstruation appeared after the treatment, and in a majority followed during the entire period of observation. The somatic and psychical symptoms of ovarian hypofunction disappeared rapidly after menstruation set in. The interval between the first irradiation and the menstruation varied, but in the majority of cases it was about twenty-eight days. It was never less than two weeks; the longest interval was ten to sixteen weeks. In some of the cases there was no improvement of the dysmenorrhea in spite of the improvement in menstrual function. There was a marked adiposity associated with hypomenorrhea in certain cases and after irradiation menstruation set in and was followed by reduction of the adiposity without employment of any other therapeutic measures. In 3 such cases the loss in weight after treatment was 13, 47 and 60 pounds respectively.

The treatment failed to achieve the desired result in 14 cases.

Holmes, George W., Dresser, Richard and Camp, John D. Lymphoblastoma. *Radiology*, July, 1926, vii, 44–50.

Eight cases of lymphoblastoma of the stomach, with roentgen studies of the gastrointestinal tract are reported. There were observed two more or less distinct types of the disease corresponding with the gross pathology as described in the literature.

In general, the gross manifestations of lymphoblastoma of the stomach may be divided into two types: (1) that in which the gastric involvement is coincident with a generalized involvement of the gastrointestinal tract, and (2) that in which the stomach alone is involved. Either of these types may or may not be associated with peripheral lymph node enlargement.

The roentgen findings were either negative or closely simulated those of gastric carcinoma. Consequently the possibility of the presence of this disease in all atypical cases showing cancer-like deformities should be considered. In some of the cases the peristalsis was not interfered with to the extent generally seen in carcinoma. In the generalized form of the disease, particularly in its early stages, the roentgenological examination may be negative.

The localized type of this disease should

respond well to radiation therapy or to a combination of irradiation and surgery.

KUPFERBERG, H. Temporary sterilization with radium rays. *Strablentherapie*, 1926, xxii, 141–147.

The radium treatment for temporary sterilization of women can be more exactly dosed, is less dangerous in its application, and not more dangerous in its effects and sequelae than the temporary roentgen sterilization, and it is therefore decidedly to be preferred over the latter. The method has only one disadvantage that it always requires clinical treatment for several days, but this may be regarded as an advantage to the radiologist who possesses radium because treatment is much cheaper than roentgenization. The author has noted another disadvantage in the case of radium treatment of cancer of the neck of the uterus. As a result of the radium destruction of the vascular endothelia, there frequently occurred recidives in cases apparently undergoing primary recovery and such cases terminated fatally with extreme hemorrhage.

In an experience in over 1200 cases of gynecological roentgen treatments there was never observed any sort of injury to the fetus in those cases subsequently coming to pregnancy. Abortion took place in a not inconsiderable proportion of such pregnancies (2 out of 15) but it is hard to decide whether this was in any way due to the previous irradiation, since these patients were suffering from some gynecological abnormality which led to their roentgen treatment.

Three cases were treated with radium for carcinoma of the uterus and 2 of them subsequently bore normal children. Ten women treated with radium for small myomas or metropathy subsequently became pregnant. Abortion took place in 4 of these cases. The remainder gave birth to normal children who have developed normally. The author's experience with the radium sterilization extends over 631 cases, in 412 of which a permanent amenorrhea was produced. In the remainder the amenorrhea was temporary (intentional and unintentional). The author employs two mesothorium preparations equivalent to 25 and 30 mg. radium element respectively. These preparations alone or together are inclosed in a nickel plated brass cylinder (wall thickness 1.5 mm.) which is covered with 1 mm. of lead-free rubber. The sterilized preparation is inserted in the uterine cavity as far as possible. Large myomas are of course not amenable to the radium treatment. The doses administered to the various gynecological conditions presented are as follows: Obstinate cervical catarrh, 250 mg-el-hr.; dysmenorrhea, 350 mg-el-hr.; polymenorrhea, 450 mg-el-hr.; adnexal disease and other conditions demanding temporary sterilization 1000 to 1200 mg-el-hr. depending on the age of the patient; osteomalacia, 2400 mg-el-hr.

MATTICK, WALTER L. Some practical considerations in the application of deep roentgen therapy to the treatment of malignant disease. *Radiology*, July, 1926, vii, 1–13.

The methods of deep roentgen therapy may be classified into (1) those useful in lesions at or near the surface, and (2) those directed at lesions in the interior of the body. The first group is used against the lesions most amenable to roentgen therapy, and includes the single field methods and treatments requiring moderate or light dosage (as in lymphosarcoma, Hodgkin's disease and leucemias). The relatively superficial lesions occurring in mammary carcinoma have not been so successfully controlled. The most approved treatment in early operable cases of mammary carcinoma is radical amputation in conjunction with postoperative and sometimes pre-operative roentgen therapy. The author has discarded the German method of roentgen therapy of mammary carcinoma in which copper-filtered massive doses are employed. He has gone back to the older plan of one or more fields of copper-filtered radiation at a moderate skin target distance of 45 cm. over the anterior chest, axilla and supraclavicular areas; a divided dose may be given extending over seven to ten days, in which time 130 to 140 per cent may be administered in four to six sittings. Although it is yet too early to determine ultimate results from this procedure, there has been observed no tendency to recurrence such as was found after the previous massive dose technique.

Two opposite parallel field cross fire methods are employed for irradiation of the cervix, body of the uterus, rectum, prostate, bladder, vagina, etc., in conjunction with radium applied locally by seeds or tubes or both. Large fields are exposed over the symphysis pubis and sacrum and the divided dose is arranged so as not to exceed 135 to 140 per cent at a distance of 3 cm. from the radium tubes, thus avoiding injury to surrounding structures. The roentgen treatments generally follow the day after radium therapy, and are repeated by the exposure of a field every day until the whole dose is given. Dosage tables are presented for the treatment of epithelioma of the cervix, lesions of the mediastinum, esophagus, tongue, tonsils, floor of mouth, larynx. In using these tables, the localizations of the parts treated were based on the anatomical cross sections of

Eycleshymer and Schoemaker. Where it is necessary to use more than two fields by cross fire methods, measurements made with the isodose curves or the field selectors of Holfelder seem always advisable, applied to an exact diagram of the part treated.

Several special methods that have proven of value are described. One of them is the three triangular field method for irradiation of localized tumors 2 or 3 cm. under the skin, as described by Stenström, Mattick and Schreiner. Another useful method especially for tumors about the knee or elbow is described as the triangular box method. The patient's extremity is placed in a triangular box which fits like a cuff about the involved part. Bolus is stuffed into the box and irradiation is given over each face so as to produce homogeneous treatment.

A method as been devised for applying a sufficient dose of roentgen rays to carcinoma of the pylorus with the avoidance of extreme injury to the patient. Three fields 10 x 15 cm. are exposed at 80 cm. skin target distance, one anterior directed caudad at an angle of 70° to the body axis, the other two fields applied at an angle of about 120° from the axial ray of the previous field, and of the same size, over the flanks directed in the same plane at an angle of 70° cephalad, all converging about the region of the pylorus.

The theories of action of the rays are briefly mentioned and dosage measurements, dosage factors, are discussed, as well as the value of massive vs. divided dosage. The results obtained since 1922 at the State Institute for the Study of Malignant Disease, Buffalo, are briefly summarized. Only about 30 per cent or less of all cases of malignancy appear to be amenable to satisfactory treatment, the remaining 70 per cent do not appear to be helped by present methods.

Minot, George R. Lymphoblastoma. *Radiology*, August, 1926, vii, 119–120.

Four hundred and twenty-seven cases of all types of lymphoblastoma excluding lymphatic leucemia have been studied. Four hundred and one of the patients are dead; 238 were treated by roentgen rays or radium and 163 were not.

Comparisons between the lengths of the course of disease in irradiated and non-irradiated patients do not indicate that such treatment significantly affects the duration of lymphoblastoma. It may do so in selected cases, and yet be blamed for the greater incidence of irradiated over non-irradiated cases of short duration in patients younger than twenty-four years. The chances of lymphoblastoma lasting long were relatively great for those first irradiated when their disease was in an early stage.

Surgery probably can influence beneficially the duration of some cases of lymphoblastoma, particularly if employed early and thoroughly and if followed by irradiation.

The average duration of the disease in the 401 deceased patients was 2.76 years, yet about 10 per cent of both the irradiated and non-irradiated had the disease for six or more years. Irradiation is undoubtedly of great value to the patients. It alleviates symptoms, decreases the size of lesions and improves the patient's efficiency in spite of the fact that it does not appear to influence importantly the duration of the disease.

Symptoms due to lymphoblastoma within the abdomen may simulate many kinds of disorders. Irradiation of abdominal lesions can alleviate markedly these patients' symptoms. Likewise rarely, the duration of a case may be extended by a radical surgical operation.

Muir, Joseph. Radio-active substances: Their therapeutic uses and applications. Radiation of cancer of the cheek. *Radiology*, August, 1926, vii, 131–136.

A review of the problem of irradiation of cancer of the cheek is briefly presented. The prime essential is control of the areas where metastases may possibly occur. Deep roentgen therapy apparently gives the best results in controlling malignancy of the cervical glands, and the earlier this is instituted the better the patient's chance of recovery or at least of lengthened life.

The chief difficulty in treating intrabuccal lesions is the practical certainty of secondary infection, consequently one is forced to administer the radium from the exterior. This is best accomplished and gives the most uniform irradiation by the employment of the platinum radon seed.

Perussia, Felice. Radiovaccination of neoplasms. *Radiol. med.*, November, 1926, xiii, 782–788.

French authors believe that if a tumor is not destroyed at once by the first dose of rays it acquires a sort of immunity, which they call radiovaccination, while the surrounding tissue, on the contrary, becomes more sensitive and is injured by later irradiations. Regaud and Nogier, in particular, consider roentgen treatment just like a surgical operation and say that a partial and fractional roentgen treatment is just as absurd as a partial fractional surgical operation would be. While Perussia admits that there are tumors which seem to improve at

first and grow worse later under successive treatments he thinks the facts may be interpreted differently. He thinks the action of the rays is to be compared to that of a drug rather than to that of surgery. The whole area of the tumor must be irradiated with a homogeneous dose, presumably strong enough to destroy the tumor cells but not strong enough to injure the normal tissues, and it is really more important not to damage the latter than it is to destroy the tumor completely at one dose. There is no such thing as a "sterilizing dose" or "carcinoma dose" anyway, for the amount required varies in different tumors, at different sites and in different individuals. All radiologists know that there are tumors which are not cured by a single irradiation which can be cured by repeated ones, and that the brilliant results with a single treatment are limited to the most favorable cases, for example, skin epitheliomas and carcinomas of the cervix.

If a carcinoma improves on the first irradiation and later grows worse it does not prove radiovaccination. It may be that the tumor was one whose sensitiveness differed very little from that of the surrounding connective tissue and the later irradiations damaged the healthy tissue to such an extent that it was no longer able to resist the invasion of the cancer. Or it may be that the first irradiations destroyed superficial parts of the tumor but that deeper seated parts that were not acted upon so strongly developed later.

Histological examinations and immunity studies have not shown that there is any such thing as radiovaccination. Nor has it been proved that normal tissue and cancer tissue react in an opposite manner to the rays. As a matter of fact, both become more radiosensitive with repeated irradiations. As a general rule, connective tissue cells are more resistant than tumor cells and require larger doses to injure or destroy them. But if too large doses are given they may be injured so that the tumor instead of being destroyed progresses more rapidly.

PFAHLER, GEORGE E. The saturation method in roentgen therapy, as applied to deep-seated malignant disease. *Brit. J. Radiol.*, February, 1926, xxxi, 45–58.

The saturation method in roentgen therapy consists in the delivery of an erythema dose into the diseased tissue within a short time, and then maintaining this effect for a certain period by means of additional smaller doses to correspond to the loss in effect during any given period. This loss seems to follow the law of mass action, and may be calculated from the logarithmic law. There is an interval of time during which the tissues recover from a saturation dose and at the end of which this dose may be repeated. It still remains to be determined how long the saturation effect can be safely continued. At present the method must be used with great caution.

PFAHLER, G. E., and WIDMANN, B. P. The relative value of various technics in the radiation treatment of carcinoma of the breast, as reflected in the statistical analysis of 701 private cases, with observations as to the general value of radiation. *Radiology*, June, 1926, vi, 493–503.

It is difficult, if not impossible, to evaluate the advantages of one technique over another in terms of figures or percentages. The various techniques employed during the past twenty-five years by Dr. Pfahler have marked a gradual development and therefore the improvements were utilized in the treatment of individual patients. Only a general idea can be formed on this account by comparing one period with another. The authors believe that clinical impressions are probably of more value than cold figures in estimating the value of improvements. The variability in the character of cases referred for treatment during any one year makes it impossible to compare with those of another year. With each improvement in technique greater hopes are aroused. Therefore the tendency is to refer more and more advanced cases with each improvement announced.

Of all cases early and late, operable and advanced, inoperable and recurrent, 50 per cent were alive three years, and 27 per cent were alive five years or more. In the postoperative group without gland involvement 81 per cent were alive three years and 77 per cent were alive five years or more. In the postoperative group with gland involvement 56 per cent were alive three years, and 38 per cent were alive five years or more.

In the above compilation all cases have been included up to the last date that they could be traced; after that they were regarded as dead.

In the local recurrent operable group, there were 69 per cent alive three years and 54 per cent alive five years or more. This observation is important to contrast with the usual experience of fulminating recurrences and metastases which are so frequent after excision.

It is impossible to judge the value of a technique by statistics unless the cases are most carefully classified according to the degree of malignancy and the extent of the disease. The tables and charts show a general improvement in end results corresponding to the improve-

ments in equipment and technique during the past few years. The authors are convinced from their clinical observations that the present technique with high voltage and filtered rays is giving better results than have ever been obtained before.

POLLOCK, HARRY L. Primary and metastatic cancer of the head. *J. Mich. M. Soc.*, March, 1926, XXV, 131–134.

In malignancies of the head and neck the sarcomas appear to have a predilection for the nose and for the sinuses, while the carcinomas tend to locate in the lips, the tongue and especially the larynx. The diagnosis is of course very essential and sometimes in the beginning it is very difficult to establish. The author emphasizes the need when making biopsies of the head and neck, especially about the nose and throat, that the section go deep enough into the growth so that a true sample can be studied.

Brief reports are given of 11 cases of carcinoma of the larynx. It is the author's experience that the so-called palliative treatments including cautery, roentgen and radium therapy, surgical diathermy, etc., have never cured a case. Nothing short of extensive surgery followed if necessary by radium and roentgen treatment gives good results. The author relies upon radical surgery, i.e., laryngofissure or laryngectomy in managing early cases because he has found that it yields cures very often.

PHILIPS, HERMAN B. Evaluation of stimulative roentgen therapy in certain surgical and neuro-circulatory diseases. *Radiology*, August, 1926, vii, 109–115.

Roentgen-ray therapy is of proven value in the treatment of (1) surgical tuberculosis, supplementing orthopedic measures; (2) pyogenic osteomyelitis, by favoring sequestration and closure of sinuses; (3) teno-synovitis (ganglion) by reducing the size of the tumors frequently with complete absorption; (4) chronic arthritis and synovitis, by ameliorating symptoms and lessening disability; (5) infantile paralysis, by overcoming hyperesthesias and improving circulatory and trophic disturbances and improving paralysis; (6) neuritis, by lessening pain; (7) thrombo-angiitis obliterans, by improving circulatory and trophic disturbances, relieving pain, hastening healing of ulcers, etc.; (8) healing of ununited fractures by stimulating callus formation.

The factors used in the treatment of surgical, tuberculous and pyogenic osteomyelitis were 100 kv., 5 mm. Al, 5 ma., 15 in. distance, 10 min. exposure, alternating on different aspects of the diseased part at weekly intervals. In deep-seated foci of infection, the penetration was increased to 140 to 160 kv., with corresponding increase in the filters and time. Caution is advised in the treatment of tuberculous spondylitis, and when treating the dorsal vertebrae it is advisable to shield the lungs as much as possible. For glangia and tenosynovitis there was used cross fire irradiation with 100 kv. and 5 mm. Al. Sub-erythema doses were given over both aspects of the part and repeated two or three times at intervals of four or six weeks. In chronic arthritis and synovitis the treatment is essentially the same, 100 kv. being used for joints of the extremities and 160 kv. for spinal or hip joints. In infantile paralysis 100 kv. with the other factors described under osteomyelitis was given at weekly intervals alternating over the anterior and posterior aspects of the involved cord segments for about four or six treatments. A rest period of one month followed by an occasional short series of treatments was given later. The cervical spine was irradiated in upper extremity involvement with the same factors but the rays were directed over each posterolateral aspect to protect the thyroid gland.

The treatment of neuritis is the same and is applied over the origin of the plexus of nerves and over the course of their distribution with 100 kv. ordinarily and 160 kv. when the parts are thick. In thrombo-angiitis obliterans the 100 kv. technique was used over the lumbar spine with some variations as to filtration and voltage. To stimulate callus formation in ununited fractures, the same general technique was utilized, the voltage depending on the thickness of the parts, but the intervals were considerably shortened, the complete stimulative dose being given in a few days' time.

SABBADINI, DARIO. Clinical and anatomico-pathological changes in the trachomatous conjunctiva as a result of the action of secondary irradiation. *Arch. di radiol.*, July-Aug., 1926, ii, 584–688.

The method used was Ghilarducci's method of secondary irradiation obtained with variable partial filtration. The author used a Record apparatus, S. H. S. tube, focal distance 23 cm., spark gap 32–35, 1 ma., 10 minutes with a filter of 3 mm. Al and 20 minutes with a filter of 5 mm. Al. The irradiation was associated with iontophoresis of the trachomatous conjunctiva and the cornea with a 0.50 per cent solution of copper and ammonium citrate with a current of 2–4 ma. Approximately 45 per cent of an erythema dose was given on the upper palpebral conjunctiva everted. In addition to this, of course there was the secondary irradiation of the copper which is

hard to calculate. Meldolesi says that the effects obtained with this treatment are: (1) a mobilization of the lymphoid cells of the trachomatous hyperplasia; (2) a dystrophic action on the epithelial hyperplasia over the lymphoid accumulations; (3) a modifying action on the cicatricial leucoma and the conjunctival scars; (4) a possible action on the specific agent of the disease.

The author gives case histories of 13 cases treated in this way including all the various clinical forms and also descriptions of the histological findings illustrated by microphotographs. He agrees with other authors who have discussed the subject that there is a direct action on the lymphoid cells which are destroyed; there is also a destructive action, but less in degree, on the so-called epithelioid cells. He does not think there is a dystrophic action on the epithelial hyperplasia over the lymphoid accumulations because in the first place there is no epithelial hyperplasia in trachoma except in a few beginning cases at the tips of the papillae; almost always there is flattening of the epithelial cells and they are dissociated and destroyed. Restoration of the epithelium in several layers is one of the most constant signs of repair of trachomatous tissue as a result of the action of secondary rays. The modifying action on the cicatricial leucoma may be due to the secondary rays or to the iontophoresis. It is questionable whether the new formation of connective tissue is due to the biological action of the secondary rays. The only thing that indicates that the new formation of tissue is not due to the ordinary stimulus of necrotic cells but to the direct stimulus of the secondary rays is the lack of marked cicatricial contraction and the tenacity with which the conjunctival connective tissue continues to proliferate for months or even years, although less actively as time goes on. He cannot conscientiously say the rays have any antibacterial action because the microorganism that causes trachoma is not known.

He does not believe that the problem of the treatment of trachoma is yet settled. Though the clinical results may be so brilliant as to make oculists believe that serious cases of trachoma are cured because of the smooth, uninfiltrated conjunctiva of a delicate rose color with no cicatricial retraction, yet the microscope shows that there is still a zone, even though it is limited, of subepithelial infiltration, which he calls the radioresistant zone in trachomatous conjunctivitis. While this zone remains the cases cannot be considered completely cured. He does not deny the value of roentgen treatment of trachoma and the method is capable of modifications which may finally bring about complete anatomico-pathological cure.

SCHOENHOF, SIEGMUND. Experiments on the indirect irradiation of skin diseases. *Strahlentherapie*, 1926, xxii, 148–159.

The influencing of lupus erythematodes by roentgen irradiation of the regional lymph glands seems to furnish further support to the view that there is some causal relationship between the dermatoses and the almost constantly accompanying chronic swelling of the lymph glands. It may be that the irradiation of the diseased glands releases decomposition products capable of immunizing the body against the causative agent and thus cure the skin condition.

In certain mature women it was observed that various dermatoses appeared in association with more or less serious menstrual disturbances such as oligo-, opso-, and amenorrhea. It therefore occurred to the author to attempt the treatment of these dermatoses by roentgen irradiation of the ovaries on the assumption that there was a causal relationship between the two conditions. This treatment was given in 8 cases after careful gynecological examination. In 4 women in whom the skin eruptions were preceded by permanent amenorrhea, the roentgenization of the ovaries was successful in the sense that the skin condition disappeared without any other treatment; and a more or less regular menstruation was reestablished. These cases are briefly described. The dose administered was $\frac{1}{10}$ to $\frac{1}{20}$ of the skin erythema dose through 0.5 mm. Zn, 25 cm. focal skin distance, to each ovary. In 2 of the cases the amenorrhea reappeared accompanied again by the dermatoses. In the above 4 cases the skin conditions found were (1) parapsoriasis atrophicans; (2) lichenoid dermatosis; (3) psoriasis; and (4) herpes labialis respectively

In the remaining 4 cases, 3 women were suffering from less extensive eczemas and one with dermatosis herpetiformis. In all of these, the roentgen treatment was followed by a regulation of the menstruation, but no effect was observed on the skin conditions. The fact that the menstrual disturbances in these cases occurred after the dermatoses had set in would indicate that the two conditions were not causally related here; except that possibly the dermatosis was the cause of the menstrual disturbance.

An additional case is described in which a twenty-seven year old woman suffered from an almost universal alopecia areata which began after her first pregnancy. She received $\frac{1}{4}$ of a skin erythema dose filtered through 3 mm. Al

over two circular fields 6 cm. in diameter in each temple, with the rays directed toward the hypophysis. A distinct new growth of hair appeared over the whole scalp within six weeks after treatment.

Soiland, Albert, and Costolow, William E. Radiation in the treatment of bone tumors. *Radiology*, July, 1926, vii, 36–38.

It may be asserted that radiation therapy has accomplished at least as much in bone tumors as any other type of treatment heretofore employed but this claim is not sufficient to stimulate further study in this direction. The authors believe from personal experience that radiation therapy is of distinct promise although the rationale of the treatment still remains to be formulated on a sound basis.

Simple bone tumors, including exostoses, certain types of bone cysts and chondromas are distinctly surgical problems. On the other hand, inflammatory tumors, sarcomas and carcinomas are preferably to be considered radiological problems. One year ago Dr. Costolow reported upon three apparently clinical cures. These three cases have been rechecked and found to be normal. Since then another striking case has been encountered.

This occurred in a woman aged fifty-six with an adamantinoma of the right lower jaw as diagnosed roentgenologically. The treatment was with radium needles buried in the mass from the inside of the mouth, together with heavily filtered high voltage roentgen therapy. The latter was repeated several times during the succeeding two years. At present, the mouth looks normal although there is still a 50 per cent enlargement of the mandible with some enlargement in the lower ramus. The cortex is not broken through and the condyle is well preserved. A cystic area remains at the junction of the body and ramus. This is the first case of an adamantinoma apparently permanently benefited by radiation.

Several cases of osteosarcoma of the sinuses have been under treatment and observation for periods varying from one to six years, with results that appear to be clinical cures.

In metastatic carcinoma of the bone it is useless to expect cure, but radiation therapy minimizes to an extraordinary degree the usual distressing symptoms. Two such cases are briefly described.

Webster, J. H. Douglas. The treatment of fifteen cases of operable carcinoma of the breast by radium and x-rays. *Brit. J. Radiol.* February, 1926, xxxi, 59–64.

It is not suggested that irradiation should be preferred to operation in operable cases of breast cancer because the radiation treatment is still too much in the experimental stage and its results are too little known so far as the effects of malignant tissues are concerned. At the same time irradiation, which has sometimes led to the complete disappearance of inoperable growths and recurrences, should give very good results in operable cases. In the series of 15 cases reported the patients either refused operation or else age, chronic bronchitis, heart disease or glycosuria made operation inadvisable. Eight of the cases received roentgen therapy alone, 2 received a combination of radium and roentgen rays and 5 received surface applications of radium.

Summarizing the total 15 cases, there have been 2 deaths, one due to an intercurrent disease, and one of the disease over two years after treatment had been discontinued. One case has an abdominal metastasis. Three are new cases, but in one of these there is now no sign of disease. One is receiving treatment for a radium dermatitis, the disease appearing arrested. The remaining 8 have been in good general and local condition for some time. The periods of observation are too short for conclusions to be drawn as to technique or results, but the subject is brought forward because it should be discussed, and the results thus far suggest that the alternative of radiation treatment can be safely offered to patients who refuse operation or in whom operation is inadvisable.

Comparing the radium with deep roentgen therapy cases there is no notable difference so far in the results. The quantity of radium necessary for a thorough treatment of breast cases is so large that only a few cases can be treated with radium in any centers at present.

Wierig, Alfons. Delayed injuries caused by roentgenization of the human body during adolescence. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, February, 1926, xxxiv, 297–301.

A report is given of a case in a girl now aged seventeen who had received an intensive roentgenization five years previously. The roentgen treatment was applied to the left side of the chest for the treatment of a condition diagnosed as lymphosarcoma of the mediastinum. The subsequent improvement suggests that the original diagnosis was probably erroneous.

Delayed roentgen injuries in the form of skin alteration, atrophy of the whole thoracic musculature and of the breast are now present in the patient. In the lung there is a cavernous cirrhotic tuberculosis. The latter condition made necessary a thoracoplastic operation which gave an opportunity for the histological examination of material from the deep verte-

bral musculature, as well as of the more superficial tissues.

The histological examination of the skin showed a distinct advanced atrophy of the whole cutis with pronounced absence of nuclei. The epithelial covering was disturbed and poorly stained in spots. There was also a high grade, somewhat irregular pigmentation of the basal layer. Immediately below the epidermis there were accumulations of enlarged capillaries around which there were often found small inflammatory foci. The sweat glands appeared distinctly pathologic. A striking finding was the slight degree of change in the larger vessels, the great majority of which appeared to be intact. Extensive degenerative changes were found in the deep muscles. The muscle fibers were no longer striated and appeared peculiarly swollen and of hazy outline. There was a partial connective tissue overgrowth and compression of the muscle fibers and in other zones the fibers had disappeared and were replaced by fatty tissue. There was extensive interstitial infiltration mostly of fixed connective tissue elements with occasional leucocytic cells. Here too the vascular changes were astonishingly slight. Occasional changes suggesting productive arteritis were seen but the majority of vessels were intact.

The above findings of pronounced injury to the deeper musculature lend support to the belief that the intensive irradiation had also injured the lung parenchyma and thus was probably contributory to the present lung condition.

WITHERS, SANFORD, RANSON, JOHN R., and HUMPHRYS, ETHEL D. Shortening the quarantine period for diphtheria convalescents and carriers. *J. Am. M. Ass.*, Oct. 16, 1926, lxxxvii, 1266–1268.

In the treatment of diphtheria carriers two methods have hitherto been employed, namely, antiseptic irradiations of the throat and tonsillectomy. Roentgen irradiation offers a third means of attack and promises to be most efficacious. It is painless, requires no anesthetic and reduces lymphoid tissue of the pharynx with no danger to the patient. It cannot be expected, however, that roentgen rays will clear up foci of infection other than those of lymphoid tissue of the pharynx.

The present report is based on 54 cases treated within the last year with strongly filtered roentgen rays generated at 200 kv. actual. The radiations were administered at 50 cm. target skin distance and filtered through 0.75 mm. Cu plus 1 mm. Al. In no case was more than 60 per cent of the erythema skin dose given. In this series there occurred after irradiation two febrile reactions resembling acute tonsillitis. Many of the cases were unsuited for roentgen treatment because they had additional pathologic conditions in the nose and throat which were not amenable to roentgen treatment alone.

As a rule, the treatments were given at the rate of 50 to 100 ma-min. to each side of the head weekly. In one case 150 ma-min. was applied to each side on the same day and there resulted a negative culture for diphtheria bacilli in four days.

Of 22 cases of clinical diphtheria there were 3 in which there was a complicating pathologic condition and there were also 5 patients to whom small doses of roentgen rays were given. Of these 22 patients, 10 of whom were carriers, all became negative in an average time of 15.8 days after having been positive an average of 43.3 days. If the experimental cases and those patients having foci of infection other than the pharyngeal lymphoid tissue are eliminated, there are left 17 patients who were positive an average of 49.7 days and who became negative and remained negative in an average of 9.5 days after the first roentgen treatment was given. Among the carriers of which there were 42, all but 3 became negative during the three months of observation. If those carriers who received experimental small doses of roentgen rays are eliminated and those with a complicating pathologic condition are also disregarded there are left 23 carriers with an average positive culture period of 60.9 days who became negative in an average of 10.9 days after the first roentgen treatment.

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